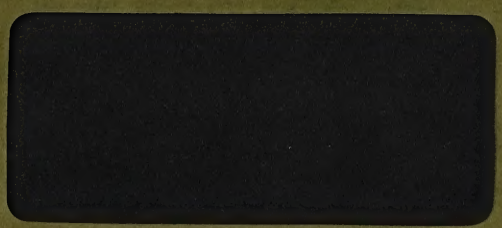
POWER SYS DEPT.

INSTRUCTION MANUAL

MULTILOGGER SC-7501
OPTION

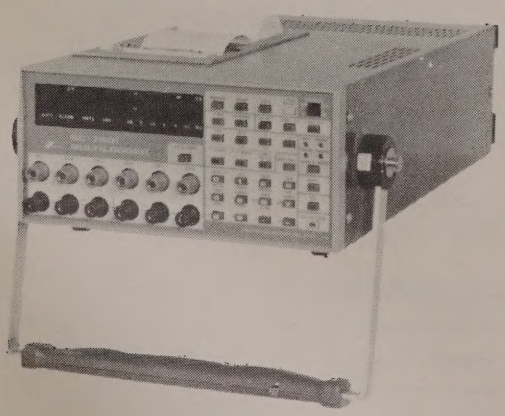
IWATSU®



YES

- GP-IB INTERFACE
  SC-0101
- CHANNEL EXTENDER
  SC-7001
- D/A CONVERSION UNIT
  SC-0102
- BATTERY INTERFACE
  SC-0103

PRINT ON ALARM



INSTRUCTION MANUAL

MULTILOGGER SC-7501

OPTION

AI-425101(L)

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Section 6 GP-IB INTERFACE (SC-0101)

6-1 GENERAL

Installing the optional GP-IB interface SC-0101 the multilogar SC-7501 is able to perform the remote control by external equipment and the data transfer to external equipment.

6-2 SPECIFICATIONS

6-2-1 Function of GP-IB

- GP-IB input/Output Signal
  TTL Open Collector Output Active Low
  TTL Input Active Low
- Number of interfaces connectable in one system is maximum 15.
  Total Length of GP-IB cable in one system is 20 m or less. However, if the total number of the interfaces is 10 or less, the cable length should be within (total number of interfaces) x 2 m totally.
- This instrument fits for use in a relatively good environment electrically.
- This instrument has functions to GP-IB as shown in Table 6-1.
- LED lights up corresponding to each mode of RMTE (REMOTE) and SRQ (SERVICE REQUEST).

Table 6-1 Functions to GP-IB

Symbol	Interface Function	Description
SH 1	Source Handshake	Complete capability
AH 1	Acceptor Handshake	Complete capability
T6	Talker	Basic talker, serial poll, Unaddress if MLA
L4	Listener	Basic listener, Unaddress if MTA
SR 1	Service Request	Complete capability
RL 1	Remote Local	Complete capability
PP 0	Parallel Poll	No capability
DC 1	Device Clear	Complete capability
DT 1	Device Trigger	Complete capability
C0	Controller	No capability

6-2-2 GP-IB Bus Line

The bus line of GP-IB is composed of 16 signal lines and 8 grounding lines. The 16 signal lines are connected to +5 V and the ground by means of the resistances of 3 kΩ and 6.2 kΩ respectively, and terminated.
The signal wires are classified into three groups functionally as follows:

- Data Bus (DIO 1 to 8)
  Transfers 8 bit 1 byte data (command) in bit parallel and byte serial.
- Handshake Bus (DAV, NRFD, NDAC)
  Performs handshake for secure transfer of the data (command).
- Control Bus (ATN, REN, IFC, SRQ, EOI)
  Used for controlling the interface system.

Gp-IB Cable

The GP-IB connector of this instrument is of 24 pins (DDK57 - 20240 - 035), and appropriate connection cable is DDK piggy back connector cable as listed below.
Also, Pin connection of the GP-IB cable connector is shown in Table 6-2.

408 J - 101 : 1 m
408 J - 102 : 2 m
408 J - 104 : 4 m

Table 6-2 Connection of GP-IB Connector Cable

Pin No.	Signal Name	Pin No.	Signal Name
1	DIO 1	13	DIO 5
2	DIO 2	14	DIO 6
3	DIO 3	15	DIO 7
4	DIO 4	16	DIO 8
5	EOI	17	REN
6	DAV	18	DAV Ground
7	NRFD	19	NRFD Ground
8	NDAC	20	NDAC Ground
9	IFC	21	IFC Ground
10	SRQ	22	SRQ Ground
11	ATN	23	ATN Ground
12	Shield	24	Logic Ground

6-2-3 Controllable Functions by GP-IB

Functions of this instrument controllable by means of GP-IB are as follows:

- Designation of channel number for CH SET, FIRST, and LAST.
- Designation of SCAN P. MODE.
- Designation of measurement function and range for each channel.
- Setting about the limit detection for each channel.
- Setting of X-Y MATH mode and Y-CONST value for each channel.
- Setting of Data of REM, TIME, and INTERVAL.
- MANUAL and SCAN measurement.
- Setting of the number of samples for $\bar{x}\sigma$, and operation of $\bar{x}\sigma$ INIT and $\bar{x}\sigma$ LIST.
- External transfer of the conditions for measurement, measured results, and results of $\bar{x}\sigma$ data processing.
- COPY, LIST, and mV ZERO cannot be operated.

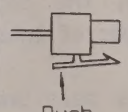
6-3 INSTALLING METHOD

Caution

In simultaneous installation of GP-IB Interface SC-0101 to SC-7501 and the channel extender SC-7001, firstly mount the connector table for SC-7001, followed by SC-0101.

1. Dismount the recording paper attached to the printer.
   For removing or replacing the recording paper, take out the remained recording paper from the housing box, and press the removing button for the recording paper strongly towards the front panel direction, then pull it to the reverse direction to that in mounting the paper.
2. Dismount the top cover.
   Dismount 6 screws on the left and right sides mounting the top cover, and remove it in the manner to make extension a little by both hands (thereby, the handle can be removed simultaneously).
3. Dismount the blind cover on the back side.
   It can be removed by taking off 2 screws (see Figure 6-1).
   Also, remove the nut and spring washer at the inside.
4. Mount SC-0101.
   Make mounting for 4 fulcrums (see Figure 6-2) and one side plate by screws.
5. Change the connection of 3-pin connector.
   Take off 3 pin receptacle (see Figure 6-2) inserted into SC-7501, and insert the board of SC-0101 (see Figure 6-3).

Caution



3-pin connector is made of lock-type, thus for removing it, pull off under the state in pressing it to the direction shown by an arrow mark. Also in mounting, confirm that it is in lock-state.

6. Connection of 10-pin and 15-pin receptacle.
   Insert the connectors of 10-pins and 15-pins of the SC-0101 (see Figure 6-3) into the board (see Figure 6-2) of SC-7501.
7. Mount the panel as accessory on the back panel.

Figure 6-1 Rear side of SC-7501

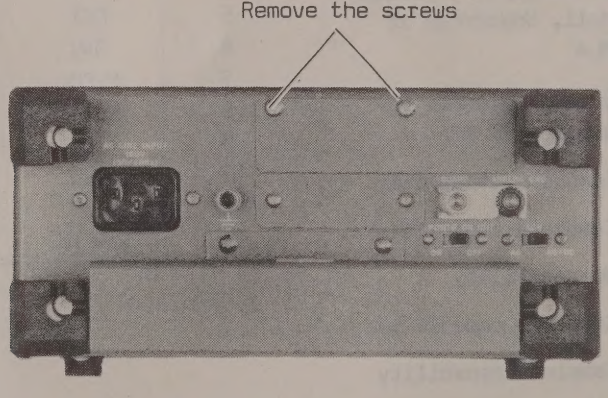


Figure 6-2 Top of SC-7501

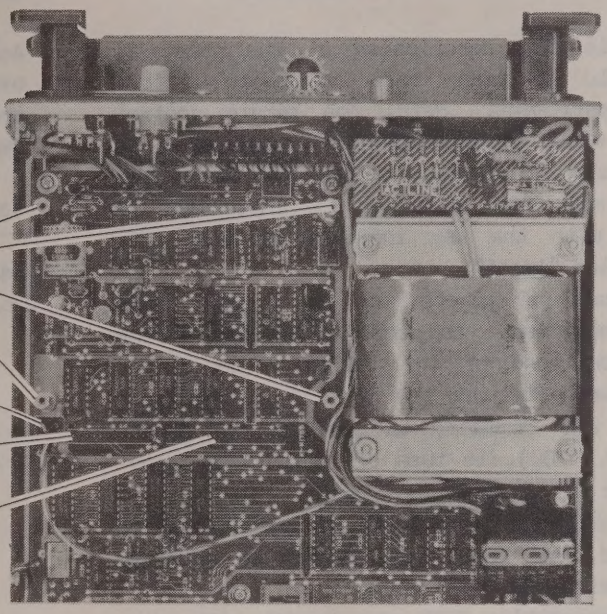
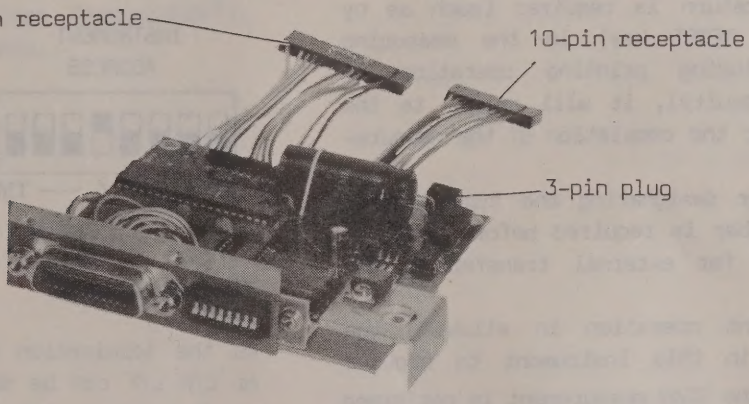


Figure 6-3 GP-IB interface SC-0101



6-4 OPERATING PROCEDURE

6-4-1 Precautions and Remote Operation

Following is the description of the point to which should be taken care in remote control of this instrument. Here, the remote control means the mode for operating the instrument in accordance with an instruction from the controller while the mode for operating the instrument in accordance with the key input of SC-7501 main body is called "local".

- In the case of remote, any key except RESET key is neglected. In order to return to the local mode, one of the following operations is necessary: to let the REN line be [False], to send GTL command, to perform the device clear (DCL, SDC), to turn off the power temporarily, or to depress RESET key.
  However, when the local lock-out mode (L.L.O) is designated, the local mode cannot be obtained by depressing the RESET key.
- In the consecutive SCAN measurement mode, passage of the beforehand specified INTERVAL TIME after the completion of one scanning would not lead to the starting of the next measurement unless a trigger instruction is generated (GET command or program code "G").
- After the completion of measurement (or when an error is found in the program code), this instrument provides service requirement (SRQ) to the controller.
- When a local return is required (such as by depressing the RESET key) in the measuring operation (including printing operation of the measured results), it will return to the local mode after the completion of the measurement.
- Program code for designating the type of data and channel number is required before designation of TALKER for external transfer to the data.
- The header print operation in allowing the printer built in this instrument to provide the results of the SCAN measurement is performed only when SCAN P. MODE is changed, or when setting of the measurement mode is performed.
- Time data (TIME and INTERVAL) setting is made in maximum 5 digits with unit of 10 sec. in the local mode, or in maximum 6 digits with the least digit for unit of 1 sec. in the remote mode.

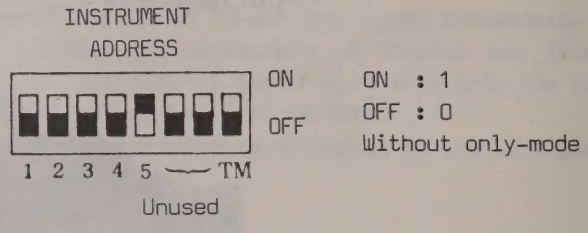
(Note) : Header Print
Activity of printing the measurement function, range, etc. from FIRST CH to LAST CH which is performed immediately after starting the SCAN or immediately after changing the SCAN P. MODE in the SCAN measurement.

6-4-2 Address Switch Setting

Addresses of this instrument can be set easily by means of the INSTRUMENT ADDRESS switches on the rear panel. Addressing method is shown in Table 6-3

Table 6-3 Addressing and Switches

Address	State of Switches 1	2	3	4	5			TM
0	0	0	0	0	0	X	X	X
1	1	0	0	0	0	X	X	X
2	0	1	0	0	0	X	X	X
3	1	1	0	0	0	X	X	X
4	0	0	1	0	0	X	X	X
5	1	0	1	0	0	X	X	X
6	0	1	1	0	0	X	X	X
7	1	1	1	0	0	X	X	X
8	0	0	0	1	0	X	X	X
•	≈							
•								
•								
29	1	0	1	1	1	X	X	X
30	0	1	1	1	1	X	X	X



TM Code Selection

As the termination code (delimiter), either C/R or C/R L/F can be selected. C/R can be selected by turning on the TM switch (right end of the INSTRUMENT ADDRESS switches) on the rear panel, while C/R L/F turning off the same switch.

Caution

The state of the INSTRUMENT ADDRESS switch is internally registered when the power is turned on, or when the device clear instruction is executed, therefore, after setting change of the address or TM code, turn the power on or execute DCL (device clear).

6-4-3 Interface Meassage Response

Following is the explanation of the activities of this instrument to the interface messages.

LLO (Local Lock Out)

This instrument transfers to the LLO mode, and would not return to the local mode even if the RESET key on the front panel is depressed.

DCL (Device Clear)

Perform device clear action, and transfers to the local mode. (See the later described "Device Clear Instruction".)

SPE (Serial Poll Enable)

Perform the serial poll mode. (See the later described "Service Request (SRQ) and Serial Poll".)

SPD (Special Poll Disable)

Gets out of the serial poll mode.

GET (Group Execute Trigger)

Execute the measurement in accordance with the measurement mode specified in advance.

GTL (Go To Local)

Transfers to the local mode.

SDC (Selected Device Clear)

Executes the device clear activity (see the later described "Device Clear Instruction"), and transfers to the LOCAL mode.

6-5 PROGRAM CODE

Following is the explanation of the remote control program code of this instrument. The program code is formed of ASCII characters, and the number of characters permitted for use in one character string is maximum 40 including the termination code. The last character in one string must be the termination code designated by means of the TM switch. (See Table 6-4 and 6-5)

Table 6-4 Program Code

Code	Contents	n
An	FIRST CH designation	1 to 12 CH (Standard) 1 to 30 CH (Option)
Bn	LAST CH designation	
Cn	CH SET designation	
D	DEVICE CLEAR (SDC)	—
En	CHn measurement condition TALK DATA set	1 to 12 CH (Standard) 1 to 30 CH (Option)
Fn	Measurement function designation	0 to 4
G	GROUP EXECUTE TRIGGER	—
Hn	HI-LIMIT value setting	±(0.0001 to 99999),0
In	INTERVAL time setting	000000 to 235959
J	—	—
Kn	REM (numeral for comment) data setting	0000 0000 to 9999 9999
Ln	LO-LIMIT value setting	±(0.0001 to 99999),0
Mn	X-Y MATH type designation	0 to 6
Nn	$\bar{x}\sigma$ maximum sample number setting	±(1 to 10000)
O	—	—
Pn	SCAN P. MODE designation	0 to 3
Q	—	—
Rn	Measures range designation	0 to 7
Sn	SCAN/MANUAL measurement mode designation	0 to 2
Tn	TIME setting	000000 to 235959
U	Conditions for measurement TALK DATA set	—
Vn	CHn measured results TALK DATA set	1 to 12 CH (Standard) 1 to 30 CH (Option)
W	—	—
Xn	$\bar{x}\sigma$ activity (INIT, LIST) and TALK DATA set	0 to 4
Yn	Y-CONST value setting	#m(1 to 30 CH#) ±(0.0001 to 99999),0
Zn	LIMIT Decision ON/OFF setting	0 to 3

(Note)
A space may be inserted between the alphabet capital and affixed character n (numeral), and between one program code and another.
(For example, "A 1 B 30 C 1 ....")

Table 6-5 shows the content of the main, frequently used program codes selected from the above table.

Table 6-5 Main Program Codes

Fn	Code	F0	F1	F2	F3	F4		
	Functions	OFF	DCV	ACV	Ω	TEMP		
Rn	Program code	Measurement Function						
		DCV		ACV		Ω		TEMP
	R0	AUTO		AUTO		AUTO		R
	R1	20mV		200mV		20		R
	R2	200mV		200mV		200		K(CA)
	R3	2V		2V		2k		T(CC)
	R4	20V		20V		20k		J(IC)
	R5	200V		200V		200k		E(CRC)
	R6	270V		270V		2M		E(CRC)
	R7	270V		270V		20M		E(CRC)
Mn	Code	M0	M1	M2	M3	M4	M5	M6
	Type of X-Y MATH	OFF	$\bar{x}\sigma$	dB	%	✳	÷	Δ
Zn	Code	Z0		Z1		Z2		Z3
	LIMIT HI	OFF		ON		OFF		ON
	LIMIT LO	OFF		OFF		ON		ON
Pn	Code	P0		P1		P2		P3
	SCAN P.	OFF		NORM		TREND		GRAPH
Sn	Code	S0		S1		S2		
	Measurement Mode	MANUAL		Single scan		Consecutive scan		
Xn	Code	X0	X1	X2	X3	X4		
	Activity	$\bar{x}\sigma$ INIT	$\bar{x}\sigma$ LIST	State	MIN MAX	$\bar{x}\sigma$		
		OPERATION		TALK DATA SET				

Following is the detail explanation of the program codes.

6-5-1 Channel Number Designation

An : FIRST CH is designated by the program code An.
Bn : LAST CH is designated by the program code Bn.
Cn : CH SET (MONITOR CH) is designated by the program code Cn.
n is the channel number to be designated, and an integral number in the range from 1 to 12. However, when optional channels are additionally installed, the number is in the range from 1 to 30.

6-5-2 Setting The Conditions For Measurement For Each Channel

Followings are the setting of conditions for measurement applied to the channels designated as the MONITOR CH (CH SET). Accordingly, after designating MONITOR CH (CH SET), set the conditions for measurement in accordance with the following program codes.

Measurement Function Setting

Fn : The measurement function is set by the program code Fn.
n is an integral number from 0 to 4. Correspondence to the measurement function is as shown in Table 6-6.

Table 6-6 Setting Program Code of Measurement Function

Code	F0	F1	F2	F3	F4
Function	OFF	DCV	ACV	Ω	TEMP

Measured Range Setting

Rn : The measured range is set by the program code Rn.
n is a digit integral number from 0 to 7. Correspondence to the measured range is as shown in Table 6-7.

Table 6-7 Measured Range Setting Program Code

Program Code	Measurement Function Range			
	DCV	ACV	Ω	TEMP
R0	AUTO	AUTO	AUTO	R *1
R1	20m	20 *2	20	R
R2	200m	200m	200	K(CA)
R3	2	2	2k	T(CC)
R4	20	20	20k	J(IC)
R5	200	200	200k	E(CRC)
R6	270	270	2M	E(CRC) *3
R7	270 *4	270 *4	20M	E(CRC) *3

*1 There is no range corresponding to R0 in TEMP measurement, it is set to R1(R).
*2 There is no range corresponding to R1 in AC V measurement, it is set to R2 (200mV range)
*3 There are no range corresponding to R6 and R7 in TEMP measurement, it is set to R5 (E).
*4 There is no range corresponding to R7 in DC V and AC V measurement, it is set to R6 (270 V range).

SETTING OF X-Y MATH TYPES

Mn : The setting of the type of X-Y MATH is based on the program code Mn.
n denotes the integer over 0 and less than 6. Table 6-8 shows its correspondence to the type of X-Y MATH.

Table 6-8 X-Y MATH Type Setting Program Code

Program Code	M0	M1	M2	M3	M4	M5	M6
X-Y MATH	OFF	$\bar{x}\sigma$	dB	Δ%	×	÷	Δ

However, $\bar{x}\sigma$ operation is permitted only in the channels 1 to 12. In addition, when the measured range is set to AUTO, any calculation except dB cannot be performed. And, the dB calculation cannot be performed except when the measurement function is SC V or DC V.

Limit Detection ON/OFF

Zn : Limit detection ON/OFF is set by the program code Zn.
n is an integral number from 0 to 3. Contents thereof are as shown in Table 6-9.

Table 6-9 Limit Detection ON/OFF Setting

Program Code		Z0	Z1	Z2	Z3
LIMIT	HI	OFF	ON	OFF	ON
	LO	OFF	OFF	ON	ON

Y-CONST value and HI-LO-LIMIT value Setting

Yn : Y-CONST value is set by the program code Yn.
Hn : HI-LIMIT value is set by the program code Hn.
Ln : LO-LIMIT value is set by the program code LN.
n is 5 digit or less decimal number (composed of a sign, decimal point, and numerals), and its permissive range is ±(0.0001 to 99999) and 0. The sign + can be omitted.
Here, a space may be inserted between the alphabet capital Y (or H, or L) and the number, and between the sign and the number, however, cannot be inserted between two numerals (or between a numeral and the decimal point).

In addition, setting the HI-LIMIT value (or LO-LIMIT value) makes the mode of performing the HI-LIMIT detection (or LO-LIMIT detection), resulting in the change of limit ON/OFF setting.

Y#m : When the channel number is designated as the value of Y-CONST, the measured result of the designated channel can be used as the Y-CONST value. The program code at this time is Y#m, wherein m is a channel number to be designated, and an integral number from 1 to 12. However, when optional channels are additionally installed, it is a number from 1 to 30.
For instance, when the channel of its own is designated as the Y-CONST value, and if X-Y MATH MODE is set to M4 (✱ data processing), the square of the measured value can be obtained.

(Example)

Correct	False
Y␣+0.123	Y␣+−0.123
Y␣−␣0.1	Y␣−␣0.␣1
Y+0.123	Y+0.1␣23
Y␣#␣12	Y␣#␣1␣2
Y␣#␣1	Y␣#+1
Y␣.1234	Y␣.12345

(Note)
Setting the value as (.12345) is considered as (0.12345). Be careful that it leads to SYNTAX ERROR by permissive digit number over.

6-5-3 N (Maximum Sample Of $\bar{X}\sigma$) Setting

Nn : The maximum number of the samples for the statistic processing $\bar{x}\sigma$ is set by the program code Nn.

n is an integral number of 5 digit decimal number or less with a sign, and the absolute value thereof should be a number from 1 to 10000.

When the sign is +, Max, Min, and $\bar{x}\sigma$ are provided to the printer at the completion of n-th measurement, and then $\bar{x}\sigma$ INIT is executed to start the measurement again. When the sign is −, Max, Min, and $\bar{x}\sigma$ are provided to the printer after the completion of n-th measurements, and the statistic processing is not performed on the measured values thereafter. Similar to the afore-mentioned, a space cannot be inserted between two numerals, and + sign can be omitted.

6-5-4 Time Data (Time, Interval) Setting

Tn : Time data is set by the program code Tn.
In : Interval data is set by the program code In.
n is an integral number of 6 digits or less, in the order of hour, minute, and second for two digits each from the top digit. Time permitted for the setting is 23 H 59 M 59 S or less. A space cannot be placed between two numerals. 000100 and 100 are both recognized as 1 minute 00 second.
When this instrument is operated in the single SCAN mode here, the INTERVAL timer is meaningless, therefore, it is necessary to actuate the trigger from the controller side at need.
In addition, time setting in the localmode is maximum 5 digits, that is, setting the one second digit is impossible and the least digit is 10 second, however, setting in the remote mode is maximum 6 digits, with the least digit is 1 second, so use care.

6-5-5 Rem (Numeral For Comment) Data Setting

Kn : Remark data is set by the program code Kn.
n is a couple of integral numbers each of a four digit decimal number separated by a space therebetween (n1 n2). Permissive range for n1 and n2 each is from 0000 to 9999.
A space cannot be placed between two numerals except between n1 and n2.
(Example)

K␣0000␣0000	Correct
K␣000000000	False
K␣0000␣00␣00	False
K␣000␣0000	False

6-5-6 Scan P. Model Setting

Pn : SCAN P. MODE is set by the program code Pn.
n is an integral number from 0 to 3. Correspondence to SCAN P. MODE is as shown in Table 6-10.

Table 6-10 SCAN P. MODE Program Code

Program Code	P0	P1	P2	P3
SCAN P. MODE	OFF	NORM	TREND	GRAPH

6-5-7 Measurement Mode Setting

Sn : Measurement mode is set by the program code Sn.
n is an integral number from 0 to 2, and the correspondence to the measurement mode is shown in Table 6-11.

Table 6-11 Measurement Mode Program Code

Program Code	S0	S1	S2
Measurement Mode	MANUAL	Single SCAN	Consecutive SCAN

MANUAL Measurement Mode! (S0)

This instrument can be designated to the MANUAL measurement mode by the program code S0. At this time, MANUAL measurement is executed by generating GET instruction (or program code G) to actuate the trigger, and after completion of the measurement leads to the generation of the service request. Meanwhile, turning the power on and performing the device clear operation allow the instrument to be set to the MANUAL (S0) measurement mode.

Single SCAN Measurement Mode (S1)

The program code S1 makes the measurement mode the single SCAN mode. This mode performs the SCAN measurement only once from the FIRST CH to the LAST CH in accordance with the trigger instruction (GET instruction or program code G). The first trigger instruction after setting the single SCAN measurement mode actuates the header print on the built-in printer, one cycle SCAN measurement, and printing of the measured results on the built-in printer, and stops the measurement. Then, provide service request (SRQ) to the controller. Next cycle SCAN measurement can be executed by the next trigger instruction. At this time, the header print is not performed. In this mode, the inner interval timer of the instrument does not related to the control of interval measurement therefore, an interval timer should be prepared at the controller side.

Consecutive SCAN Measurement Mode (S2)

The program code S2 leads to the consecutive SCAN mode. In this measurement mode, SCAN measurement is performed in accordance with the inner interval timer of the instrument. However, passing the interval time would not automatically actuate the next measurement unless trigger instruction is delivered each time SCAN is completed. That is, after setting the consecutive SCAN measurement mode, the first cycle of SCAN measurement is executed by the similar operation as in the above-mentioned "Single SCAN Measurement Mode" (S1), however, in order to execute the SCAN measurement on and after the second cycle, following two conditions should be satisfied.

- Trigger instruction is received after the completion of the previous measurement.
- The interval time specified in advance has passed from the completion of previous measurement.

Under these conditions, start the next measurement. Format of the measured data print-out on the built-in printer and the header print executed in the first cycle scanning is determined in accordance with the SCAN P. MODE (program code Pn) specified in advance. For further detail of the printing format, see the afore-mentioned "SCAN Measurement".
If SCAN P. MODE is changed on the way, the new SCAN P. MODE is used from the first SCAN Measurement after that change, and the header print is also executed.
In addition, in the remote mode, the monitor measurement is not performed while waiting for the passage of the interval time.

6-5-8 Measurement Trigger Instruction

G (GET) : Measurement trigger (measurement start) of this instrument is performed by the program code G.

Same operation is executed by the bus line command GET (Group Execute Trigger).

6-5-9 Device Clear Instruction

D (DCL) (SDC) : Device clear operation is performed by the program code D.

Following is an explanation of the device clear operation.

- Equipment address and termination code (delimeter) of the instrument is re-registered in accordance with the state of the INSTRUMENT ADDRESS switches on the rear panel of this instrument. (See the afore-mentioned "Address Switch Setting".)
- The measurement mode is initialized (it will be the MANUAL measurement mode).
- $\bar{x}\sigma$ INIT operation is performed.
- Cancelling the service request (SRQ), it returns to the local mode.

Same operation is performed by the bus line command DCL (Device Clear), and SDC (Selected Device Clear).
Pay attention here to the fact that the equip-

ment address registered inside the instrument is not changed by only changing the setting of the INSTRUMENT ADDRESS switches. Accordingly, if an address command SDC (or program code D) is ordered at this time against the address after change would not be accepted.
When changing the address, or when the state of the internally registered address is unknown, perform the device clear operation by the bus line command DCL, or turn on the power again. After performing the device clear instruction, it is necessary to wait for about 100 m SEC. until the next GP-IB command is accepted.

6-5-10 $\bar{X}\sigma$INIT, $\bar{X}\sigma$LIST, And TALK DATA SET

Xn : Instruction about $\bar{x}\sigma$ are performed by the program code Xn.
n is an integral number from 0 to 4. Correspondence of the program code and the operation is shown in Table 6-12.

Table 6-12 $\bar{x}\sigma$ operation Program Code

Program Code	X0	X1	X2	X3	X4
Content of Operation	$\bar{x}\sigma$ INIT	$\bar{x}\sigma$ LIST	State	MAX, MIN	$\bar{x}\sigma$
			TALK DATA SET		

$\bar{X}\sigma$ INT (X0)

$\bar{x}\sigma$ INIT operation is performed by the program code X0. This performs the initialization of the statistic processing. When executing the statistic processing (designate $\bar{x}\sigma$ as the type of X-Y MATH, program code is M1), $\bar{x}\sigma$ INIT should be performed prior to starting the measurement on the first sample. $\bar{x}\sigma$ INIT is performed also by the device clear operation.

$\bar{X}\sigma$ LIST (X1)

The results of the statistic processing at that time is provided on the printer built in the instrument by the program code X1. Printing format is the same as in the local mode.

$\bar{X}\sigma$ TALK DATA SET (X2, X3, X4)

The program codes X2, X3 and X4 perform the designation of content of the data on the results of the statistic processing to be transferred externally. As the MONITOR CH is the object channel, designate the channel whose data is necessary as the MONITOR CH (program code Cn : n is in the frange from 1 to 12), and then deliver the program code Xn (n is from 2 to 4) according to the required data content, and thereafter designate this instrument as the TALKER. Then, the results of the statistic processing will be transferred.

If the MONITOR CH is designated to a 13 CH or more channel when the program code X2, X3 or X4 is received, do not set data, error SRQ is set, and it will wait for GP-IB command.

$\bar{X}\sigma$CONDITION TALK DATA SET (X2)

Data output in accordance with the program code X2 are the channel number of the MONITOR CH, measurement function, maximum sample number, total measuring number and effective measuring number. For the TALKER DATA FORMAT, see the later described "TALKER DATA FORMAT".

$\bar{X}\sigma$MAX, MIN TALK DATA SET (X3)

Data output in accordance with the program code X3 are the maximum value and minimum value of the effective measurement values. For the TALKER DATA FORMAT, see the later described "TALKER DATA FORMAT". However, when the effective measuring number is zero, $\bar{x}\sigma$ CONDITION TALK DATA is set. (See the previous "$\bar{x}\sigma$ CONDITION TALK DATA SET".)

$\bar{X}\sigma$ TALK DATA SET (X4)

Data output in accordance with the program code X4 are the average value and standard variation of the effective measured data. For the TALKER DATA FORMAT, see the later described "TALKER DATA FORMAT". However, when the effective measuring time is zero, $\bar{x}\sigma$ CONDITION TALK DATA is set (see the previous "$\bar{x}\sigma$ CONDITION TALK DATA SET (X2)"). In addition, time little less than 200 m SEC is required for the calculation of the average value and the standard variation so that the controller should wait for a proper time after sending the program code X4 before designating this instrument as the TALKER.

Precautions on $\bar{X}\sigma$Caliculation

When performing $\bar{x}\sigma$ calculation, use care to the following points:

- Before measuring the first sample, execute $\bar{x}\sigma$ INIT.
- After starting the measurement on the first sample, do not change the measurement function and measuring range before all the necessary data collection is finished.

6-5-11 Measured Results And Measurement Condition Data Transfer

Vn : Data transfer of the measured results is designated by the program code Vn.

En : Data transfer of the conditions for measurement for each channel is designated by the program code En.

n is an integral number from 1 to 12, which designate the channel number from which the data is necessary. (When optional channels are additionally installed, n is from 1 to 30.)

U : Data transfer of the conditions for measurement about the whole measurement is designated by the program code U.

In order to transfer the data of the measured results (or data of the conditions for measurement) externally from this instrument, first set the data designated by the program code Vn (or En, or U) in the data output buffer, and then designate this instrument as the TALKER. This permits the transfer of the required data from this equipment.

For the content of the output data, and the DATA FORMAT, see the following "TALKER DATA FORMAT".

6-6. TALKER DATA FORMAT

6-6-1 Measured Results (Output Corresponding To The Program Code "Vn")

Provide by 20 byte ASCII code.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
F	D	N	X	0	1	␣	±	1	.	2	3	4	5	E	±	0	2	C/R	L/F

First byte for FIRST CH/LAST CH code (One capital alphabet letter):

F : When the designated CH is FIRST CH.
: When the designated CH is LAST CH.
S : When the designated CH are both FIRST CH and LAST CH.
- : When the designated CH is neither FIRST CH nor LAST CH.

Second byte for measurement function (One capital alphabet letter):

D : Measurement function is DC V measurement.
A : Measurement function is AC V measurement.
R : Measurement function is resistance measurement.
T : Measurement function is temperature measurement.
: Measurement function if OFF.

Third byte for limit detection result code (One capital alphabet letter):

N : NORMAL (PASS)
O : Overflow or BURN OUT
H : HI-LIMIT OUT
L : LO-LIMIT OUT
E : ERROR (Both HI-LIMIT and LO-LIMIT OUT)

Four byte for $\bar{x}\sigma$ data processing Completion Display Code (One capital alphabet letter):

X : Total number of measurements reaches the beforehand specified maximum sample number.
␣ : Total number of measurements does not reach the beforehand specified maximum sample number.

From 5th byte to 6th byte for designated channel number (2 digits number)

From 8th byte to 18th byte for E format data:

Mantissa (sign, decimal point, 5 digits number) --- from 8th byte to 14th byte.
Exponent (Capital alphabet letter E, sign, two digits number) --- from 15th byte to 18th byte

From 19th byte to 20th byte for delimiter:

C/R by TM switch ON (In this case, data of 19 bytes)
C/R L/F by TM switch OFF

6-6-2 Conditions For Measurement (Output Corresponding To The Program Code "En")

Provide by 42 byte ASCII code.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
E	0	1	F	0	R	0	M	0	Z	1	Y	0	␣	Y	±	0	.	1	2	3	4

23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
␣	H	±	5	.	6	7	8	9	␣	L	±	9	.	8	7	6	5	C/R	L/F

From first to third byte for Channel Number:

Capital alphabet letter "E" + two digit number of the channel number.

From 4th to 11th byte for measurement condition code:

code: (Measurement function, range, X-Y MATH type, and limit decision ON/OFF)
Respectively capital alphabet letters ("F", "R", "M", "Z") + a one-digit number.
Correspondence of the code and the actual condition is the same as in the program code.

From 12th to 13th byte for Y-CONST mode:

Y0 : When the Y-CONST is a numeral data.
Y1 : When the Y-CONST is CH number.

From 14th to 22nd byte for Y-CONST value:

When Y-CONST is a number
  Capital alphabet "Y" + real number data (sign + 5 digits + decimal point)
When Y-CONST is an integral number
  Capital alphabet "Y" + real number data (sign + "␣" + 5 digits)
When Y-CONST is CH data
  Capital alphabet "Y" + "␣␣␣␣" + "#" + "2 digit CH number."

From 24th to 31st byte for HI-LIMIT value:

Capital alphabet "H" + real number data

From 33rd to 40th byte for LO-LIMIT value:

Capital alphabet "L" + real number data

From 41st to 42nd byte for termination code (delimiter):

C/R with TM switch ON (In this case, data of 41 bytes)
C/R L/F with TM switch OFF

6-6-3 Conditions For The Whole Measurement (Output Corresponding To The Program Code "U")

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A	0	1	B	1	2	C	1	2	S	1	P	0	␣	K	0	0	0	0

20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
␣	9	9	9	9	␣	I	2	3	5	9	5	9	␣	N	±	1	0	0

39	40	41	42
0	0	C/R	L/F

From first to 9th byte for FIRST, LAST and CH SET channel numbers:

Capital alphabet "A" + FIRST CH channel number (2 digits number)
Capital alphabet "B" + LAST CH channel number (2 digits number)
Capital alphabet "C" + CH SET channel number (2 digits number)

From 10th to 11th byte for measurement model:

S0 : MANUAL
S1 : Single SCAN
S2 : Consecutive SCAN

From 12th to 13rd byte for SCAN PRINT MODE:

Capital alphabet "P" + one digit number. Correspondence of the code and the actual MODE is the same in the program code.

From 15th to 24th byte for Remark data:

Capital alphabet "K" + 4 digit 1st REM data + 4 digits 2nd REM data.

From 26th to 32nd byte for INTERVAL TIME:

Capital alphabet "I" + 6 digit number.

From 34th to 40th byte for $\overline{x}\sigma$ data processing maximum sample number set value:

Capital alphabet "N" + sign + 5 digits number

From 41st to 42nd byte for delimiter:

C/R (in this case data of 41 byte) or C/R L/F by the TM switch on the rear panel.

6-6-4 $\overline{X}\sigma$ Data Processing Results (Output Corresponding To The Program Codes X2, X3 And X4)

$\overline{X}\sigma$ CONDITION (Corresponding to X2)

Output by 29 byte ASCII code.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
X	0	1	␣	D	␣	N	±	1	0	0	0	0	␣	T	1	0	0	0

20	21	22	23	24	25	26	27	28	29
0	␣	E	1	0	0	0	0	C/R	L/F

From 1st to 3rd byte for CH SET channel ($\overline{x}\sigma$ data processing results output channel number):

Fifth byte for measurement function code (One capital alphabet letter):

D : Measurement function DC V
A : Measurement function AC V
R : Measurement function Resistance
T : Measurement function Temperature
␣ : Measurement function OFF

From 7th to 13rd byte for $\overline{x}\sigma$ maximum sample number set value:

Capital alphabet "N" + sign + 5 digits number.

From 15th to 20th byte for total measurement count.

count.
Capital alphabet "T" + 5 digits number.

From 22nd to 27th byte for effective measurement con count.

Capital alphabet "E" + 5 digits number.

From 28th to 29th byte for delimiter:

C/R (in this case, data of 28 bytes) or C/R L/F in accordance with TM switch on the rear panel.

MAX, MIN DATA (Corresponding To X3)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
M	N	±	1	.	9	9	9	9	E	±	0	0	␣	M	X	±	1	.
20	21	22	23	24	25	26	27		28			29						
9	9	9	9	E	±	0	0		C/R			L/F						

From 1st to 13th byte for Minimum Value Data (MIN):

Capital alphabets "MN" + E format data.

From 15th to 27th byte for Maximum Value Data (MAX):

Capital alphabets "MX" + E format data.
- E format data
- Mantissa
  - Sign, decimal point, 5 digit number
- Exponent
  - Capital alphabet E (Exp), sign, two digits number

From 28th to 29th byte for delimiter:
C/R (in this case, data of 28 bytes) or C/R L/F in accordance with the TM switch on the rear panel.

$\bar{X}\sigma$ DATA (Corresponding To X4)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A	±	1	.	9	9	9	9	0	E	±	0	0	␣	S	±	0	.	0
20	21	22	23	24	25	26	27		28			29						
0	0	0	1	E	±	0	0		C/R			L/F						

From 1st to 13th byte for average value data ($\bar{x}$ AVE data):
Capital alphabet "A" + E format data.

From 15th to 27th byte for standard variation data:

Capital alphabet "S" + E format data (σ SIGMA data)
- E format data
- Mantissa
  - Sign, decimal point, 6 digit number
- Exponent
  - Capital alphabet E (Exp), sign, two digit number

From 28th to 29th byte for delimiter:
C/R (in this case, data for 28 bytes) or C/R L/F in accordance with the TM switch on the rear panel.

6-7 SERVICE REQUEST (SRQ) AND SERIAL POLL

This instrument sends service request to the controller in three cases: upon completion of measurement, when the total number of measurements reaches the maximum sample number, and when SYNTAX ERROR occurred in the program code. (Let SRQ line be [True].) Also, status byte is set according to each case.
The controller is capable of identification of the device which issued the service request, and of judgement of the reasons for the request by performing the serial poll operation. When this instrument is designated to the TALKER in the serial poll mode, it provides the status byte message to the controller.
Bit allocation of the status byte message of this instrument is as shown below.

MSB							LSB
0	X_7	X_6	0	0	0	X_2	X_1

X7 : 1 at the time of service request (True)
X6 : 1 in case of SYNTAX ERROR (True)
X2 : 1 when the total number of measurement reaches the maximum sample number (True)
X1 : 1 upon completion of measurement (True)
The above can be expressed in the form of code as shown in Table 6-13.

Table 6-13

Reasons for Oscillation	STATUS BYTE		
	Binary	Decimal	Hexadecimal
SYNTAX ERROR	MSB LSB 01100000	96	60
$\bar{x}\sigma$ END	01000011	67	43
MEAS, END	01000001	65	41

If this instrument is the origin of the service request, X7 bit is always 1 (True), and at the same time, at least one of either X1, X2 and X6 is 1 (True). In addition, when X2 and X7 are both 1 (True), X1 also is 1 (True).
If this instrument is not the origin of the service request, X7 bit is 0 (False). When this instrument provides the service request, SRQ indicator lamp on the front panel lights up to inform of this state. In order to release the service request of this instrument, any one of the followings is necessary: execution of serial poll, device clear instruction (bus line command

DCL, SDC program code D), or returning to the local.

Caution

If the service request is once set in this instrument, SRQ is kept as set to (True) unless released by any one of the above-mentioned methods.
Accordingly, when completion of the measurement is to be detected by the monitoring SRQ line, it is necessary to release the service request after the service request is set and before the next trigger instruction is issued.

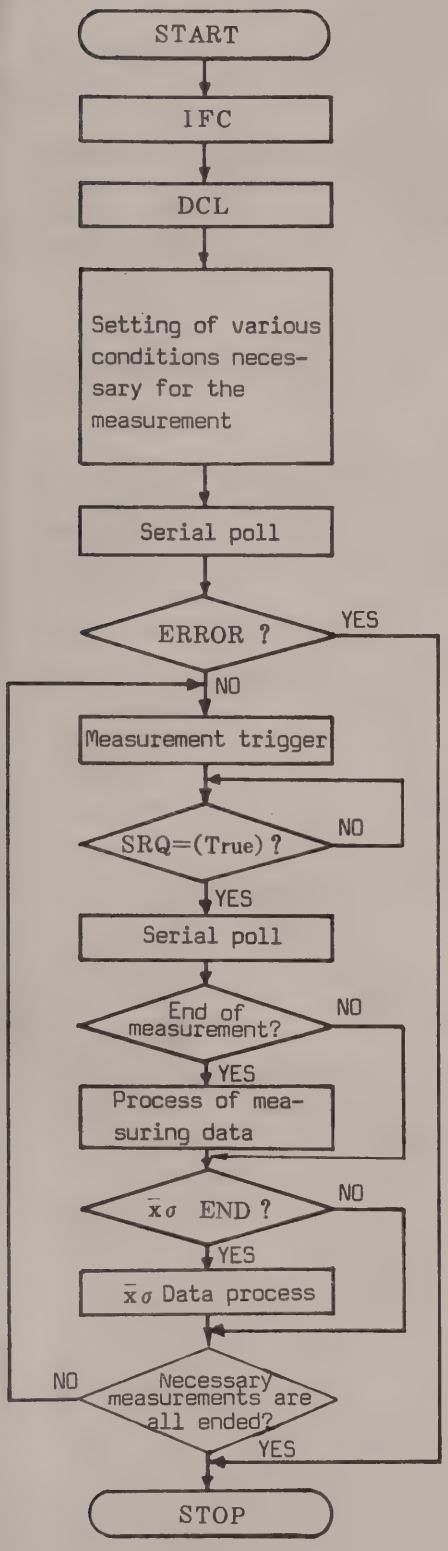
6-8 CONTROLLER

Use care that some controllers usable for GP-IB have insufficient functions partially.

Controller Program

Figure 6-4 is an example of flow chart of the controller program.

Figure 6-4 Controller Program



INTERFACE CLEAR

DEVICE CLEAR
Address registration, $\bar{x}\sigma$ INIT, etc. are performed.

Set the conditions necessary for the measurement by the program code
(Example)

```
S2P2A1B12T134000I000100 C/R L/F
K1981␣0907N+100         C/R L/F
C1F1R0M2Z0Y+10000       C/R L/F
C2F1R4M0H+10.000L-10.000 C/R L/F
      ⋮
C12F4R3M1Z0             C/R L/F
```

Check the existence of SYNTAX ERROR by means of the status byte.
(See "Service Request (SRQ) and Serial Poll".)
ERROR STATUS = 01100000 (60H)

Bus line command GET or program code "G" C/R L/F.
(See "Measurement Trigger Instruction".)
Wait until SRQ becomes (True).

Read the status byte by the serial poll (SRQ release)
(See "Service Request (SRQ) and Serial Poll".)
Measurement End Status = 01000001

Data Read by the program code "Vn" C/R L/F.
(See "Measured Results, Measurement Condition Data Transfer and Measured Result (Output Corresponding to the program code Vn).)
$\bar{x}\sigma$ END STATUS = 01000011

$\bar{x}\sigma$ data processing by the program code "Xn" C/R L/F.
(See "$\bar{x}\sigma$ INIT, PRINT and TALK DATA SET, and $\bar{x}\sigma$ Data Processing Results (Output Corresponding to the program codes X2, X3, and X4)".)

Section 7 CHANNEL EXTENDER (SC-7001)

7-1 GENERAL

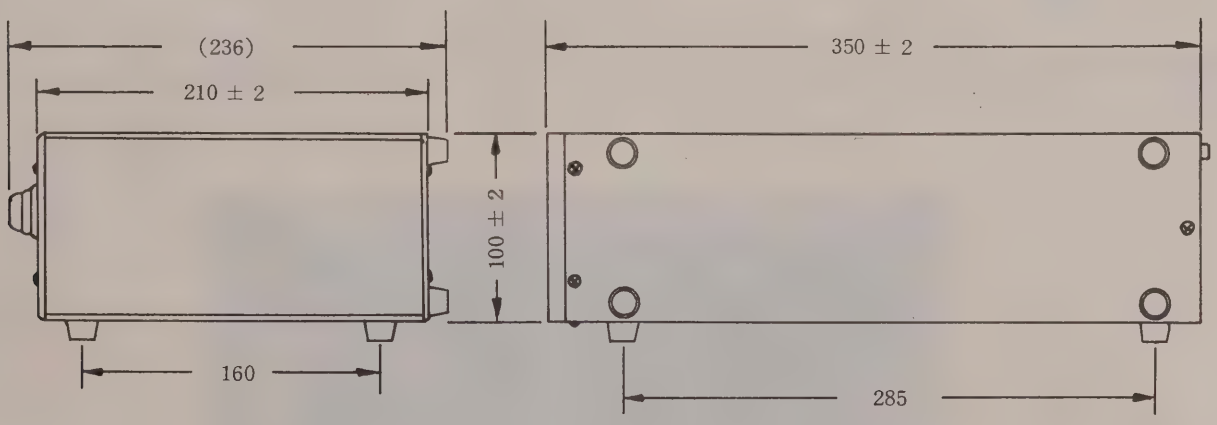
Connecting the optional channel extender SC-7001 allows the multi-logger SC-7501 to extend 18 measuring channels for use in measuring dc voltage or temperature.

7-2 SPECIFICATIONS

Number of Measuring Channels : 18
In combination with SC-7501, up to 30 channels are usable in the dc voltage measuring mode, and up to 24 channels in the temperature measuring mode.

Electric Characteristics :
Conforms to SC-7501, except that print-out can be obtained only 1 channel to 12 channel in the TREND mode, if the channel extender SC-7001 is connected.
Weight : Approximately 2.4 kg
Dimensions : (210±2)W x (100±2)H x (350±2)L mm
(See Figure 7-1.)
Operating Temperature Range : 0°C to 50°C
Operating Humidity Range : 80% RH or less
(0°C to 40°C)
60% RH or less
(40°C to 50°C)
Warranting Temperature : 18°C to 28°C
Warranting Humidity : 80% RH or less
(18°C to 28°C)

Figure 7-1 Dimensions



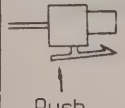
7-3 CHANNEL EXTENDER (SC-7001)

Installation Procedure

When the channel extender SC-7001 is installed on the SC-7501 together with another option, be sure to connect the connector cable of the SC-7001 first, and then that option.

1. Remove the printing paper from the printer. For removing or replacing the recording paper, pull out the remainder of the paper from the case box, and push the paper removing button towards the front panel at a jerk while pulling the paper in the direction opposite to that of installation.
2. Detach the top and bottom covers. Disconnect 6 screws that fix the top cover on the right and left side panels, and remove the cover upward with the right and left side covers somewhat opened externally with your hands. (The handle will be also detached at this time.)
3. Detach the shield case on the bottom. It can be detached by disconnecting the screws in four places.
4. Remove the blind cap on the rear side. It can be removed by disconnecting the screws in two places (see Figure 7-2). Also remove the nuts and spring washers which are internally attached.
5. Connect the connector for the channel extender (see Figure 7-3) at the position where the blind cap was located. (See Figure 7-4.)
6. Connect the connector pin 15 (see Figure 9-3) to the bottom board (see Figure 7-5).
7. Connect the connector pin 3 (see Figure 9-3) to the top board (see Figure 7-6).

Caution



Since the connector pin 3 is of the lock type, in order to disconnect it, it must be pulled out while pushed in the arrow direction. When connecting it, make sure that it is locked.

Figure 7-2 Rear View of the SC-7501

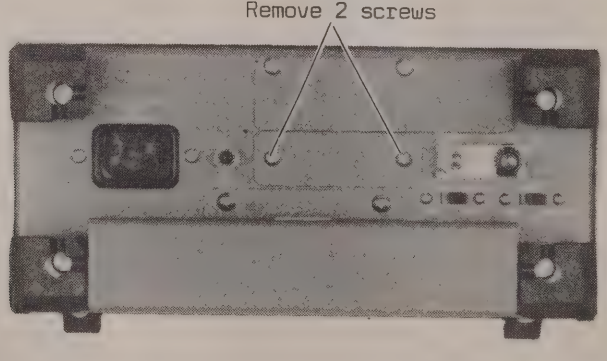


Figure 7-3 Connector with Cable

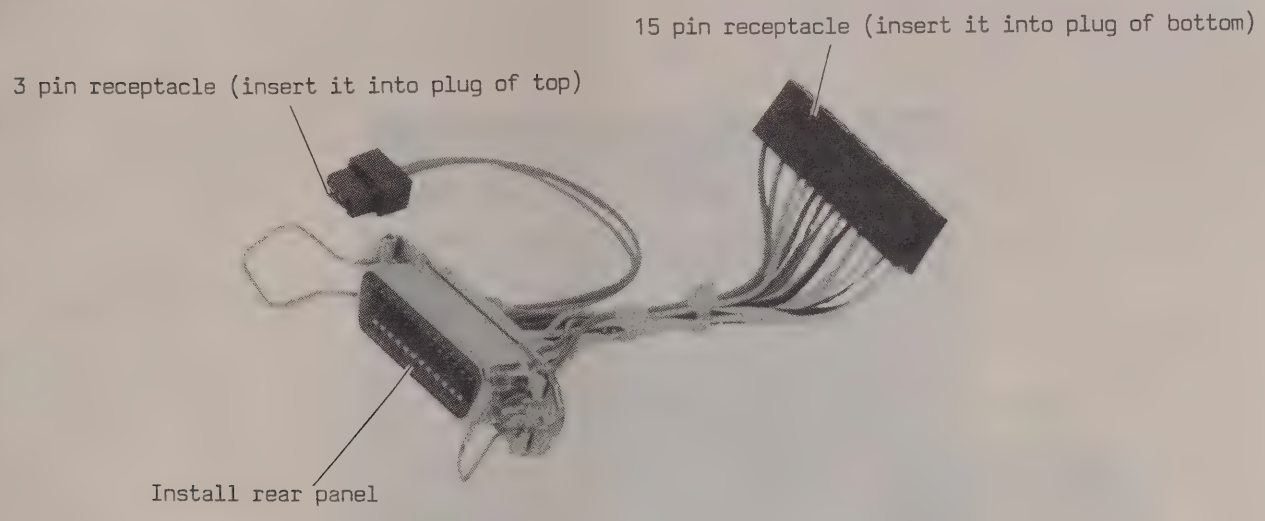


Figure 7-4 Rear panel of SC-7501

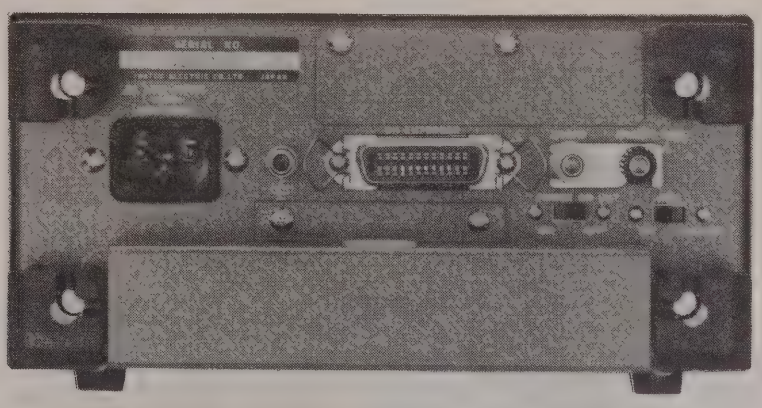


Figure 7-5 Bottom of SC-7501

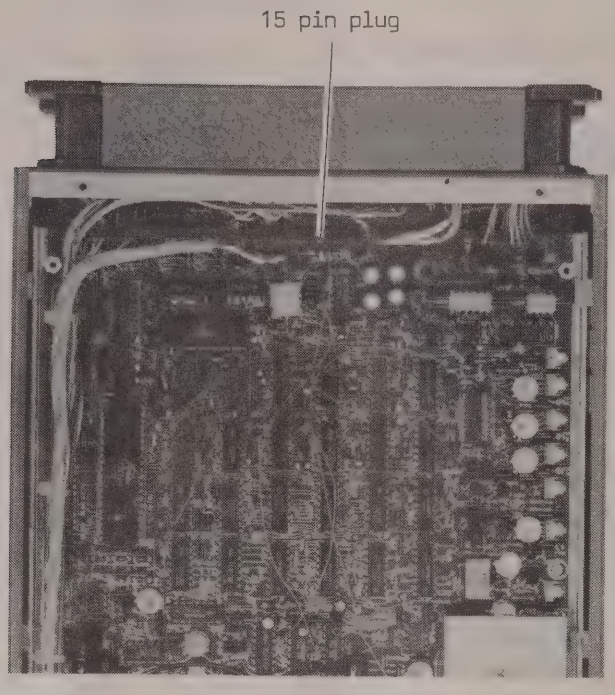
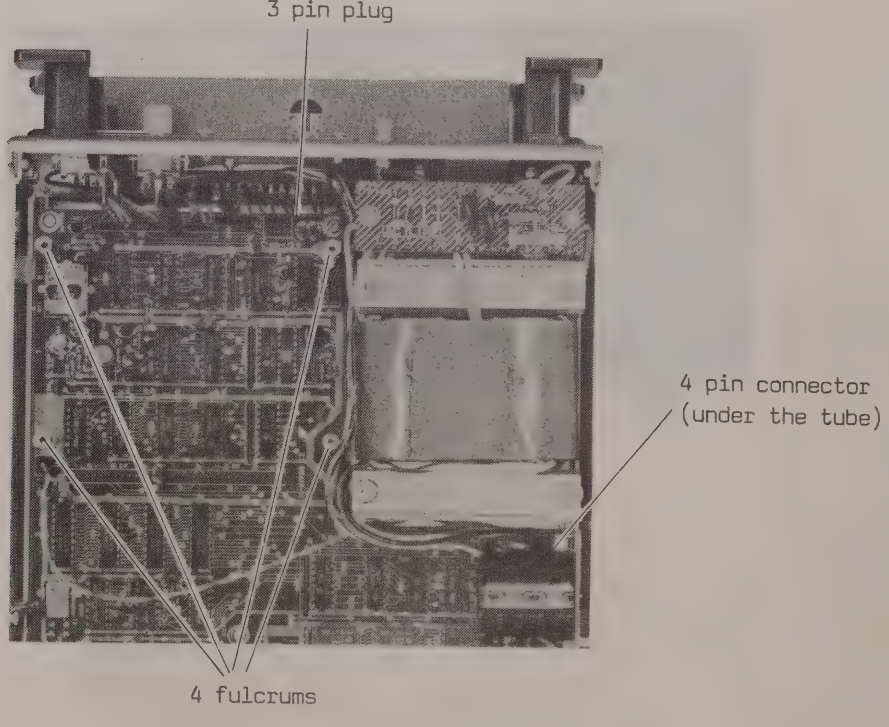


Figure 7-6 Top of SC-7501



7-4 OPERATING PROCEDURE

When using the channel extender SC-7001, connect the cable connector of the SC-7001 to the channel extender connector (J102) on the rear panel of SC-7501. (See Figure 7-7.) Be sure to turn off the power switch of the SC-7501 in case of connecting or removing the SC-7001 cable connector.

Connecting Input Signal Lead-in Wire

Before connecting the input signal lead-in wire to the input terminal, first remove 2 setscrews which fix the cover on the input terminal as shown in Figure 7-8, and slide the cover a little to the rear side (backward) to remove it.
Then, connect the input signal lead-in wire to the input terminal, and fix the cover. At this time, take out the lead-in wire through the hole under the cover.

Cautions

- Use care not mistake the polarity (HI, LO terminals) when connecting the input signal lead-in wire to the input terminal.
- When connecting the input signal lead-in wire to the input terminal, connect them securely, especially in measuring the temperature.
- In measuring the temperature, twist and securely attach the + foot of the compensating conductor or the thermocouple to the HI terminal of the input terminal and the - foot to LO terminal.
- When measuring the temperature, exposing the input terminal to the wind directly or touching it by your hand directly will cause heat electromotive force, resulting in the measurement error. Fix surely the cover of input terminal. If your hand touches it, leave it for several minutes before starting the measurement.

Figure 7-8 Input terminal

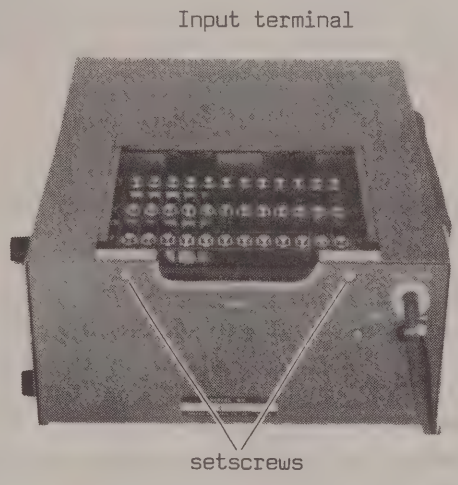
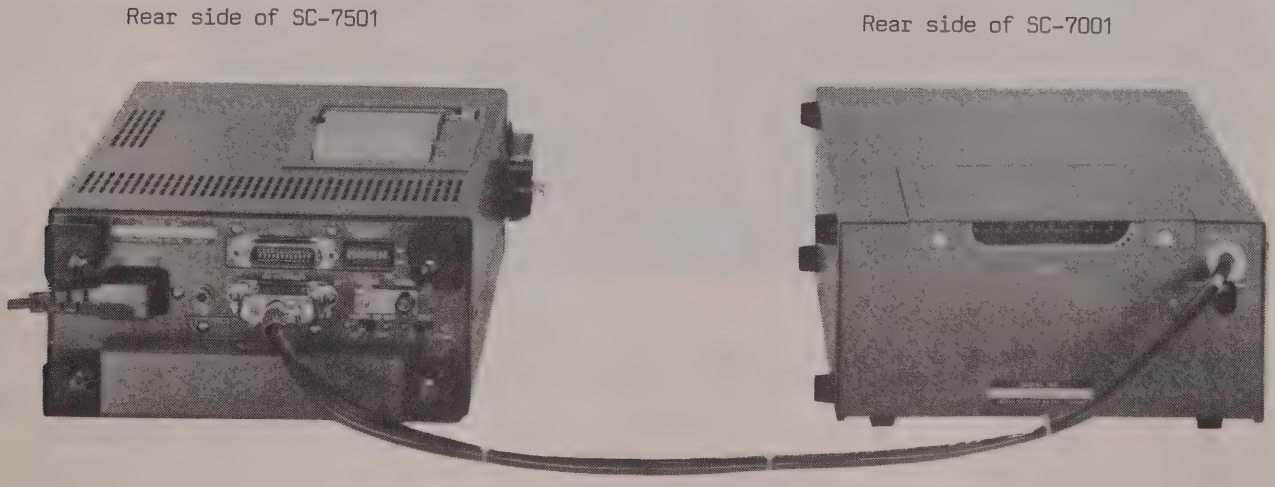


Figure 7-7 Connecting SC-7001 to SC-7501



7-5 MEASURING PROCEDURE

For the procedures of measuring dc voltage and temperature, refer to the sections of "DC Voltage Measuring" and "Temperature Measuring" in SC-7501 Instruction Manual.

7-6 ABOUT THERMOCOUPLE

For the types of thermocouples, errors of the thermocouple temperature measurement and precautions of the thermocouple temperature measurement, refer to the section of "About Thermocouple" in SC-7501 Instruction Manual.

7-7 CHECK AND ADJUSTMENT

In order to take correct measurements, each circuit in the channel extender SC-7001 should operate correctly, and specifications of the channel extender SC-7001 should be always maintained in good condition.
Check and adjust the SC-7001 every about 6 months, and the reliable specifications will be maintained for a long term.

7-7-1 Precautions on Check and Adjustment

In checking and adjusting, observe the following precautions:

- Set the ambient temperature to the normal temperature (+23°C ± 5°C), and the humidity to 80% RH or less.
- Confirm the AC line source voltage, connect SC-7001 to SC-7501, specifications of which has been checked and adjusted, turn on the power, and warm-up for about 30 minutes.

7-7-2 Checking DC Voltage Measurement

Checking each range

1. Set the CH SET to the CH 13.
2. Check if the display value shows as listed in Table 7-1 when the appropriate input voltage is applied for each range.

Use the copper series input signal lead-in wire, which has a small heat electromotive force.

Table 7-1

Range	Input Voltage	Check indication ±00.009
20mV	+ 19.000	18.985 to 19.015
	- 19.000	-18.985 to 19.015
200mV	+ 190.00	189.91 to 190.09
2 V	+ 1.9000	1.8993 to 1.9007
20 V	+ 19.000	18.993 to 19.007
200 V	+ 190.00	189.93 to 190.07
270 V	+ 270.0	269.8 to 270.2

Checking SCAN measurement of all channels

1. Set the CH 1 as the FIRST CH.
2. Set the CH 30 as the LAST CH.
3. Set the all channels to DC V and 20 mV, and apply 19.000 mV to the all channels.
4. Set the SCAN P. MODE and take the SCAN measurement. Check if the printed value for each channel is "18.985 to 19.015" at this time.

7-7-3 Checking and Adjusting Temperature Measurement

Checking adjusting temperature zero point

In the check and adjustment of temperature measurement, check and adjust the temperature zero point first.

1. Remove the cover and connect the thermocouple T(CC) to the input terminal of CH 22. At this time connect the + foot (Cu) of the thermocouple to the input terminal HI and the - foot (C) to the LO.
2. Set the cover of the input terminal so as to avoid exposing the input terminal to the wind.
3. Set the keys on SC-7501 as follows:

CH SET	CH 22
Measuring Function	TEMP
Range	T

4. Connect each as shown in Figure 7-9. At this time, check if the display of the platinum resistance temperature detector digital thermometer is the same as the display of this instrument.
5. If out of the rating, adjust R2 (see Figure 7-10). The rating for check if ±000.4°C.

Cautions

- As the temperature measurement of the reference point is performed every about four seconds in monitor mode, wait for about 4 seconds after adjustment of R2, check the display.
- Check and adjust after 10 minutes or more since the thermocouple was connected to the input terminal.
- Check and adjust after 30 minutes or more since the tip end of each of the thermocouple and the platinum resistance temperature detector was inserted in the water.

Checking full-scale and zero

Succeeding to the previous section, check the full scale and zero of the temperature measurement.

1. Connect the calibrator voltages to CH13, and check as follows.
2. Set S3 (see Figure 5-1 in the SC-7501 instruction manual) to ON.
3. Check as listed in Table 7-2. (Adjustment of full scale for each range has already performed in the step of the afore-mentioned "Check and adjustment of the SC-7501", therefore, only the check is performed here.)
4. After the completion of check, return S3 to OFF.

Figure 7-9 Connection of the SC-7001 and Platinum Resistance Temperature Detector Digital Thermometer

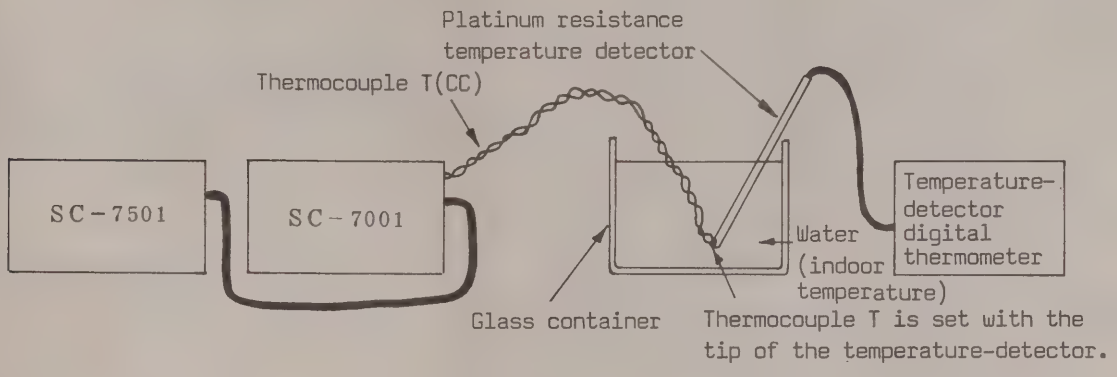


Figure 7-10 Adjuster on Left Side

Table 7-2 Check of Temperature Measurement

Range	Calibrator Voltage (mV)	Center Temperature (°C)	Limits for Check
R	-1	- OVER	- OVER
	0	0	±3.6
	+4.471	+500.0	496.4 to 503.6
	+18.842	+1600.0	1596.4 to 1603.6
	+22.0	+ OVER	+ OVER
K (CA)	-5.891	-200.0	-198.2 to -201.8
	0	0	±2.3
	+20.640	+500.0	497.7 to 502.3
	+54.807	+1370.0	1367.7 to 1372.3
T (CC)	-5.603	-200.0	-198.9 to -201.1
	0	0	±0.9
	+4.277	+100.0	99.1 to 100.9
	+19.638	+380.0	379.1 to 380.9
J (IC)	-7.890	-200.0	-199.1 to -200.9
	0	0	±2.0
	+27.388	+500.0	498.0 to 502.0
	+51.875	+900.0	898.0 to 902.0
E (CRC)	-8.824	-200.0	-199.1 to -200.9
	0	0	±2.2
	+36.999	+500.0	497.8 to 502.2
	+76.358	+1000.0	997.8 to 1002.2

Section 8 D/A CONVERSION UNIT (SC-0102)

8-1 GENERAL

Installing the optional D/A conversion unit SC-0102 to the multi-logger SC-7501 allows the digital data on the monitor channel of the SC-7501 to be converted to the analog data, so that the data can be recorded when the analog recorder is connected.
Also, the limit detection output on the monitor channel can be externally taken out by means of the open collector output, according to the LIMIT value set in SC-7501. It is electrically isolated from the analog system of the SC-7501 main body.
In addition, only one optional equipment of GP-IB interface SC-0101, D/A conversion unit SC-0102, and battery interface SC-0103 can be connected to the multi-logger SC-7501.

8-2 SPECIFICATIONS

D/A Conversion

D/A Output Channel : Monitor Channel
Output Voltage : ± 999 mV full scale
(When A/D and data processing overflows in SC-7501, it results in ± 1.1 V or more.)
Polarity : Polarity of the measured data is also D/A converted.
Conversion Accuracy :
± 0.3% of Full Scale (23°C ± 5°C, 80% RH or less)
± 0.5% of Full Scale (0°C to 50°C,60% RH or less)
Conversion Speed : Approximately 10 mSEC or less
(Time for reaching the range of accuracy under the output voltage from 0 to the full scale.)
D/A Output Range :
3 digits out of the 5 digit data.
Three ranges are available as below, according to the set position (right, center, and left) of the column select switch.
19999 ← SC-7501 Data
■■■ ← Lower three digits analog output
■■■ ← Intermediate three digits analog output
■■■ ← Upper three digits analog output
Output Resistance : Approximately 1 kΩ
Selection of Central Value of D/A Conversion :
Changeable in two modes of the offset 0 and 500 by means of the OFFSET push-button switch. (See Table 8-1.)

Table 8-1

Offset	Digital Display	±000	±500	±999
0	D/A Output	±000mV	±500mV	±999mV
Offset	Digital Display	±500	±000	±499
500	D/A Output	±000mV	±500mV	±999mV

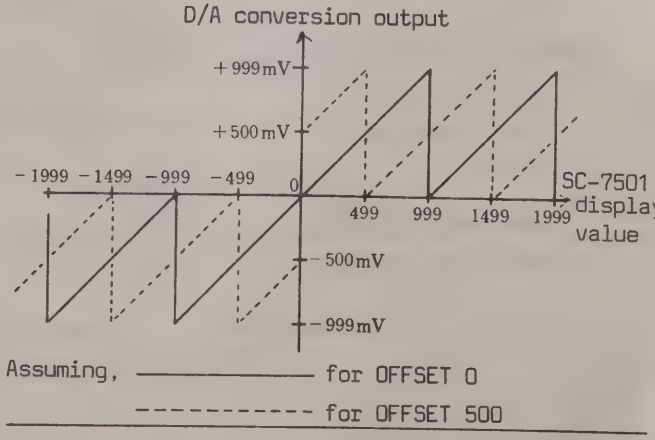
Figure 8-1 shows the relation between the SC-7501 display value and the D/A conversion output.

Limit Detection Output

Limit Detection Output Channel : Monitor Channel
Limit Detection Level :
HI and LO LIMIT values set in SC-7501.
Conditions for Limit Detection :
HI : Measured Data > HI LIMIT
GO : LO LIMIT ≦ Measured Data ≦ HI LIMIT
LO : Measured Data < LO LIMIT
- The detection is performed including the polarity.
- The limit detection is not performed when the measuring funciton of the SC-7501 is in the auto range mode.
- When the limit detection level of the SC-7501 is not set, GO will be provided.

Limit Detection Output Form :
Open collector output for all of HI, GO and LO.
Voltage between the collector and emitter:
DC + 30V MAX
Collector current : DC + 50mA MAX

Figure 8-1 OFFSET 0/500 D/A Conversion Output (When the column select switch is set to the lower position.)



Timing of D/A Output and Limit Detection Output

In SCAN Measurement Mode : See Figure 8-2
In Monitor Measurement Mode :
Outputs D/A and limit detection each time the measurement is taken.

Connecting Output Connector

Output Connector Type : DDK57-40140
Adapting Plug Type : DDK57-30140
Connections of Pins of Output Connector :
See Table 8-2.
Open Collector Output : Negative logic
The circuit of the open collector output is shown in Figure 8-3.

General Specifications

Supply Voltage : +5 V, 7.6 V AC
Supplied from SC-7501
Operating Temperature Range : 0°C to 50°C
Operating Humidity Range :
80% RH or less, 0°C to 40°C
60% RH or less, 40°C to 50°C
General View : See Figure 8-4

Accessories

Connector Plug (DDK57-30140)	1
Fitting screw (SM5-3 x 6)	4

Table 8-2 Output Connector Pin Connection

Pin No.	Signal Name	Output Form	Pin No.	Signal Name	Output Form
1	D/A Conversion Output	———	8	Limit Detection Completion	For approximately 24 mS (Negative Logic), TTL level fan out
2	GND for D/A	———			
3	Scale Over Output	"1" in case of scale over, TTL LS fan out 1.	9	———	———
4	GND		10	———	———
5	Limit Detection HI Output	Open collector output, Negative logic	11	———	———
			12	———	———
6	Limit Detection LO Output	Open collector output, Negative logic	13	———	———
7	Limit Detection GO Output	Open collector output, Negative logic	14	———	———

Figure 8-2 In SCAN Measurement Mode

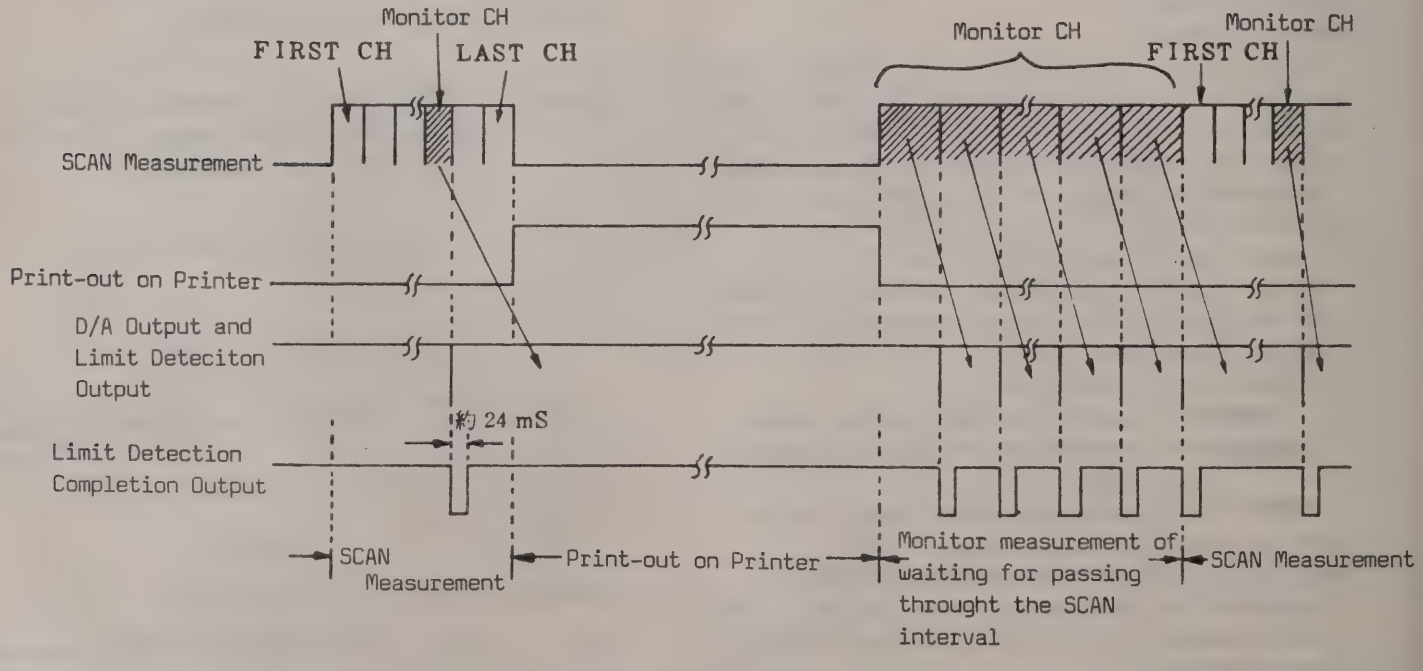
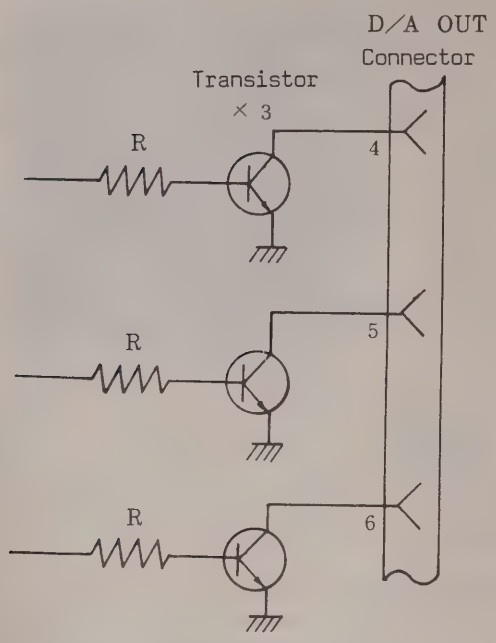


Figure 8-3 Open Collector Output
(Limit Detection HI, LO and GO Output)



8-3 D/A CONVERSION UNIT (SC-0102)

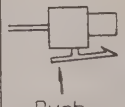
Installation Procedure

Caution

If you want to have the SC-7501 equipped with both the D/A conversion unit SC-0102 and the channel extender SC-7001 at a time, be sure to connect the connector cable of the SC-7001 first, and then the SC-0102.

1. Remove the recording paper from the printer.
   For removing or replacing the recording paper, take out the remainder of the paper from the case box, and push the paper removing button with a jerk towards the front panel while pulling the paper in the direction opposite from that of installation.
2. Detach the top cover.
   Remove 6 screws fixing the top cover on the right and left side plates, and detach it upward, somewhat opening the right and left side covers externally with your hands. (The handle will be also detached at the same time.)
3. Detach the blind cap on the rear side.
   Remove the screws in two places on the rear side (see Figure 8-4), and the blind cap may be detached. Also remove the nuts and spring washers which are internally attached.
4. Install the SC-0102.
   Fix it on the stays in four places (see Figure 8-5) with screws.
5. Change the connection of the connector pin 3.
   Pull out the connector pin 3 which is connected to the SC-7501 (see Figure 8-5), and connect it to the board of the SC-0102 (see Figure 8-6).

Caution



Since the connector pin 3 is of the lock type, in order to disconnect it, it must be pulled out as it is pushed in the arrow direction. When connecting it, make sure that it is locked.

6. Connect the connector pins 10 and 15.
   Connect the connector pins 10 and 15 of the SC-0102 (see Figure 8-7) to the board of the SC-7501 (see Figure 8-5).
7. Install the supplied panel on the rear side panel.

Figure 8-4 General View

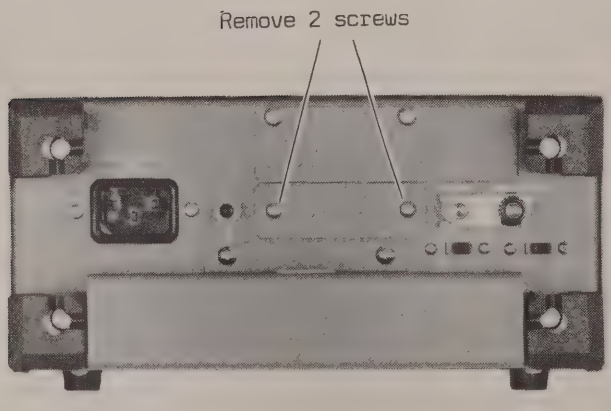


Figure 8-5 Top of SC-7501

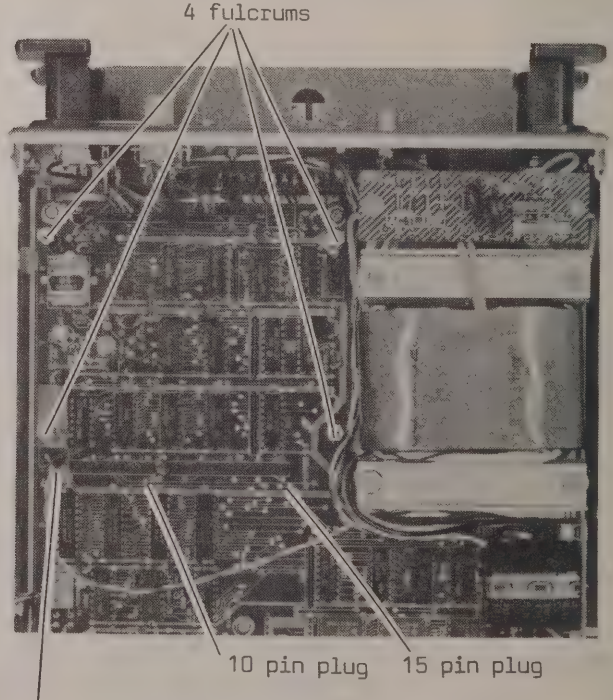


Figure 8-6 Top of SC-0102

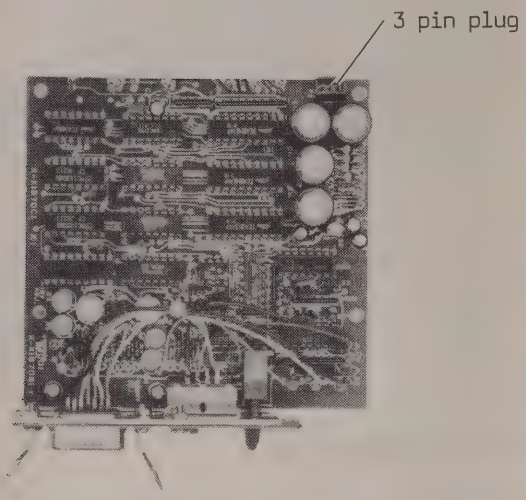
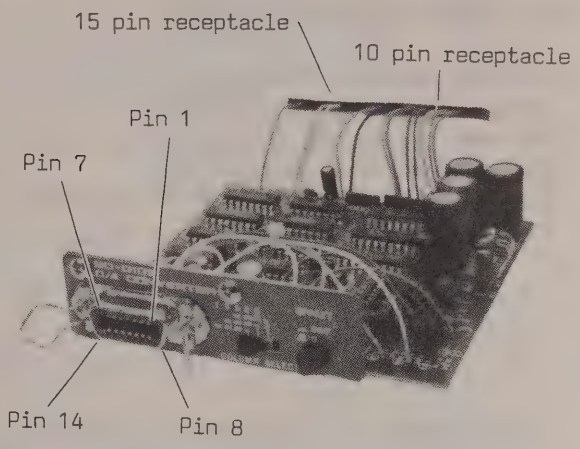


Figure 8-7 SC-0102



8-4 OPERATING PROCEDURE

8-4-1 How to Use D/A Conversion

1. Set the measuring function and others on the monitor channel of the SC-7501.
2. Set the COLUMN SELECT switch of SC-0102 to the desired D/A conversion range.
   < Example>
   - If set to the lower three digits, 19999 fine change of the input signals can be recorded in the analog recorder.
   - If set to the upper three digits, 19999 resolution will be worse, however, overall analog data of the input signal can be obtained.
3. Output will be obtained as shown in Table 8-1 and Figure 8-1 previously mentioned, according to the setting of the SC-0102 OFFSET switch to 0 or 500.
   In other words, setting the OFFSET to 0 provides the D/A output which corresponds to the SC-7501 display value, while setting the OFFSET to 500 provide the D/A output obtained by adding 500 mV (1/2 full scale).
   When measuring the voltage, resistance, temperature, and sending the D/A outputs thereof to the analog recorder for recording, if input value near the full scale is provided, it may change suddenly to 0. Therefore, it the OFFSET is set to 0, it is difficult to catch the correct data.
   In this case, if set OFFSET to 500, the full scale data provides D/A output of one half of it. So dissolve the sudden change of D/A output. This leads to the understandable data recorded by the analog recorder. (See Figure 8-1.)
4. D/A output is taken out of the pin 1 (D/A output) and pin 2 (GND) of the supplied D/A output connector DDK57-30140.

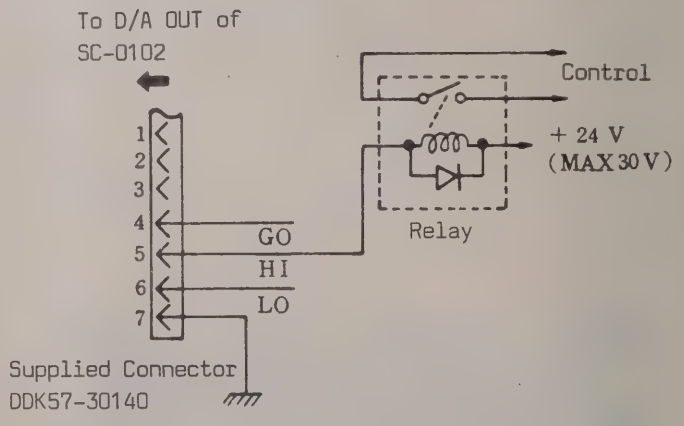
8-4-2 How to Use Limit Detection Output

1. Set the measuring function and values of LIMIT HI and LO on the monitor channel of SC-7501.
2. The limit detection signals will be provided from the pin 5 (HI output), pin 6 (LO output), and pin 7 (GO output) of the supplied connector DDK57-30140 connected to the output connector of the SC-0102. (See Table 8-2.)
3. The timing chart of the limit detection result is given in Figure 8-2 mentioned before, the result of the limit detection that triggered with the limit detection completion output is provided at the completion of the monitor channel measurement.

How to Connect to Relay

Figure 8-8 shows the connecting method for turning on and off the external relay by using the limit output of the SC-0102.

Figure 8-8 Connection of External Relay



8-5 CHECK AND ADJUSTMENT

In order to take correct measurement, each circuit in the D/A conversion unit SC-0102 should operate correctly, and the specifications of the SC-0102 should be always maintained in good condition.
Check and adjust the SC-0102 every about 6 months, and the reliable specifications will be maintained for a long term.

8-5-1 Precautions

In making the performance check and adjustment, observe the following precautions:

- Set the ambient temperature to the normal temperature (+23°C ± 5°C), and the humidity to 80% RH or less.
- Confirm the AC line source voltage, connect the unit to the SC-7501, specifications of which has been checked and adjusted, turn on the power, and warm up for about 30 minutes.

8-5-2 Check and Adjustment Items and Equipment Required

The equipments required are listed as follows
1. Digital multi-meters ... 2V measurable and 100 μV full scale
2. Power supply dc level ... +5V
3. Resisters (3 required) ... Approximately 10 kΩ

Check and adjustment items are listed as follows Be sure to perform the check and adjustment in the order given below (in numerical order).
1. Check the power supply dc level.
2. Check and adjust D/A conversion.
3. Check the limit deteciton output.

8-5-3 Checking the Power Supply DC Level

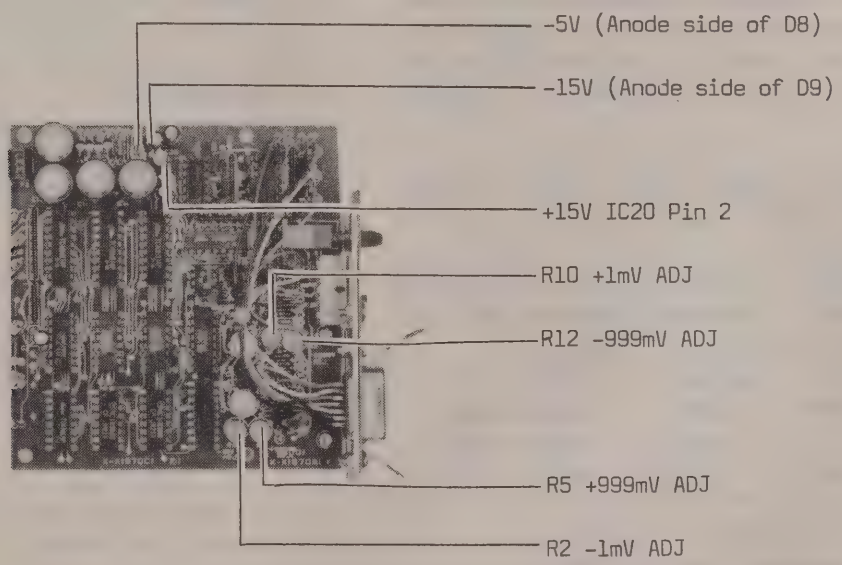
Rating
Each voltage range are listed in Table 8-3.

Table 8-3

Power Supply dc level	Voltage Range (V)	Measuring Point
+ 15	+ 14.25 to 15.75	IC20 pin 2
- 15	- 13.8 to 15.6	D9
- 5	- 4.8 to 5.4	D8

Check
1. Connect the digital multi-meter between the ground (cathode side of D9) and the measuring point as shown in Figure 8-9, and check if the voltage range of the power supply dc level is within the rating.

Figure 8-9 Adjusters and Test Points



8-5-4 Checking and Adjusting D/A Conversion

Rating

Output voltage (voltage between the pins 1 and 2 of the output connector) shall be within the range as listed in Table 8-4, 8-5 and 8-6.

Table 8-4 When COLUMN SELECT switch is set to lower side, and OFFSET is 0

Order of Adjustment	SC-7501 Y CONST Set Value	SC-7501 Display Value	Output Voltage Range (Between Connector Pins 1 and 1)	Reference Designators
1	.0001	-0.0001	-0.5 to -1.5	R 2 } See
2	.0999	-0.0999	-996.0to-100.2	R12 } Fig-
3	-.0001	+0.0001	+0.5 to+1.5	R10 } ure
4	-.0999	+0.0999	+996.0to+100.2	R 5 } 8-9

Set DC V to 2 V range.

Table 8-5 When set COLUMN SELECT switch to upper OFFSET switch to 0

Order of Adjustment	SC-7501 Y CONST Set Value	SC-7501 Display Value	Output Voltage Range (Between Connector Pins 1 and 2)
5	0	±00000	±003
6	-9.99	+9.9900	+996 to -1002
7	9.99	-9.9900	-996 to -1002
8	Input + 2V or more	␣␣␣␣␣	+1.1V or less
9	Input - 2V or more	␣␣␣␣␣	-1.1V or less

Set DC V to 2 V range. In addition, the input terminal is shorted for the checking and adjusting orders from 1 to 7, and ± 2 V or more is applied for the orders 8 and 9 (enclosed with a thick line).

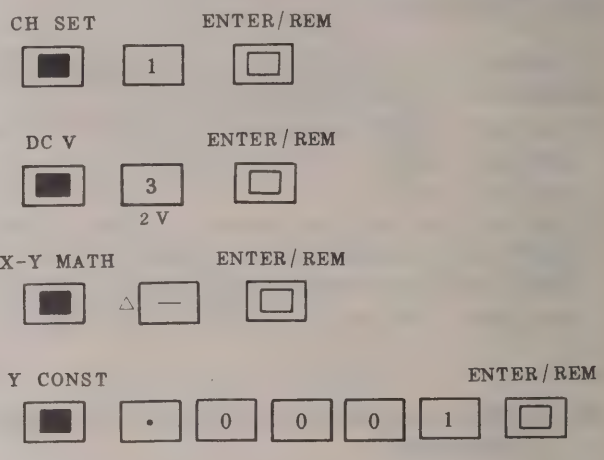
Table 8-6 When set COLUMN SELECT switch to lower and the OFFSET switch to 500

Order of Adjustment	SC-7501 Y CONST Set Value	SC-7501 Display Value	Output Voltage Range (Between Connector Pins 1 and 2)
10	0	+00000	497 to 503
11	-.0499	+0.0499	+996 to +1002
12	0	-00000	-497 to -503
13	.0499	-0.0499	-996 to -1002

Set DC V to 2 V range. In addition, for the checking and adjusting orders from 10 to 13, the input terminal should be shorted.

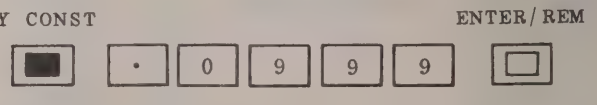
Check and Adjustment

1. Set the COLUMN SELECT switch of the D/A conversion unit SC-0102 to the lower position (right side), and OFFSET to 0.
2. Short-circuit the input terminal (between HI and LO) of CH 1 of SC-7501, and connect the digital multi-meter between the pins 1 and 2 of the output connector of SC-0102. (Connect the pin 1 to HI of the digital multi-meter, and pin 2 to LO.)
3. Set the keys of SC-7501 as follows:



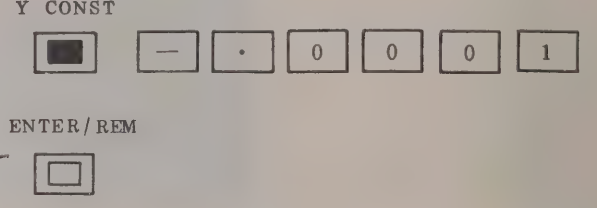
At this time, check the adjusting order 1 in Table 8-4.

4. If out of the rating, adjust R2 (see Figure 8-6).
5. Set the keys of SC-7501 as follows:



At this time, check the adjusting order 2 in Table 8-4.

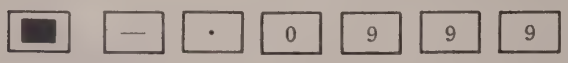
6. If out of the rating, adjust R12 (see Figure 8-10).
7. Set the keys of SC-7501 as follows:



At this time, check the adjusting order 3 as described above.

8. If out of the rating, adjust R10 (see Figure 8-9).
9. Set the keys of SC-7501 as follows:

Y CONST



ENTER/REM

At this time, check the adjusting order 4.

10. If out of the rating, adjust R5 (see Figure 8-9).
11. Then, on Tables 8-5 and 8-6 also, check the Y CONST value of SC-7501 by the digital multi-meter in the same manner as described above according to the order of check.
Remember at this time that the column select switch and OFFSET switch should be set to the upper position (left side) and 0 respectively for Table 8-5, and to the lower position (right side) and 500 respectively for Table 8-6.

8-5-5 Checking the Limit Detection Output

Rating
The limit detection output voltage should be within the voltage range as listed in Table 8-7.

Table 8-7

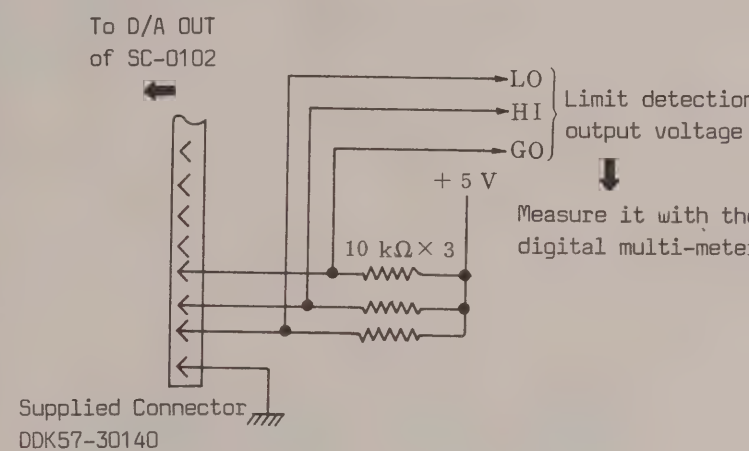
Order of Check	SC-7501 Input Voltage	Limit Detection Output Voltage (Display Value of Digital Multi-meter)		
		GO	HI	LO
1	approx. + 1.5V	4 to 5V	0 to 0.5V	4 to 5V
2	0V	0 to 0.5V	4 to 5V	4 to 5V
3	approx. - 1.5V	4 to 5V	4 to 5V	0 to 0.5V

Check
1. Make the circuit as shown in Figure 8-10 in the supplied connector (DDK57-30140), and connector to D/A OUT of the D/A conversion unit.
2. Using the digital multi-meter, measure between the limit detection output voltage GO (pin 4) and the ground.
3. Set the keys of SC-7501 as follows:

CH SET	1
Measuring Function	DC V
Range	2V
LIMIT HI	+1V
LIMIT LO	-1V

4. Apply approximately +1.5 V to the input terminal of the channel 1. At this time, check if the display value of the digital multi-meter is as given in the checking order 1 in Table 8-7.
5. Set the input voltage to 0 V, and check if the digital multi-meter display value is as given in the checking order 2 in Table 8-7.
6. Apply the input voltage of approximately -1.5 V, and in the same manner as described above, check if the display value is as shown in the checking order 3 in Table 8-7.

Figure 8-10 Limit Detection



Section 9 BATTERY INTERFACE (SC-0103)

9-1 GENERAL

Installing the optional battery interface SC-0103 allows the multi-logger SC-7501 to be operated in cordless state by using a car battery (- side grounded, + 12 V) and an external battery (+ 12 V) as the power source for SC-7501.
Only one of the optional GP-IB interface SC-0101, D/A conversion unit SC-0102, and battery interface SC-0103 can be connected to the multi-logger SC-7501.

9-2 SPECIFICATIONS

Input Voltage : 12 V DC (9.6 V to 14.4 V)
Operating Time : Usable for about 5 consecutive hours if fully charged (when using 12 V, 3.5 AH, Ni - cd), the measurement of the SC-7501 is taken with the SCAN interval of 1 minute on 12 channels in SCAN mode, and is printed in the NORM mode.
Input Current : 1.2 A ± 20%
with a printer operated
0.58 A ± 20%
with no printer operated
Battery - AC Line Change :
Automatic (Turning AC line OFF is detected.)
Operating Temperature Range : 0°C to 40°C
Operating Humidity Range :
80% RH or less, (0°C to 40°C)

Accessories

Car Battery Cord (KHB048921)	1
Fitting Screw (SM5 - 3x5)	4
Fuse (FSA - 5)	2

However, no battery pack nor specified charger (available in market) is included.

Caution

The battery interface is usable only with a car battery that is of 12 V series and grounded at the - side.

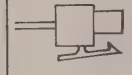
9-3 BATTERY INTERFACE

Installation Procedure

Caution

If you want to have the SC-7501 equipped with both the battery interface SC-0103 and the channel extender SC-7001 at a time, be sure to install the connector cable of the SC-7001 first, and then the SC-0103.

1. Remove the recording paper from the printer.
   For removing or replacing the recording paper, take out the remainder of the paper from the case box, and push the paper removing button towards the front panel with a jerk while pulling the paper in the direction opposite to that of installation.
2. Remove the cover of the top surface.
   Disconnect 6 screws fixing the top cover on the right and left side panels, and remove the top cover upward with the right and left side covers somewhat opened externally with your hands. (The handle will be also detached at this time.)
3. Detach the blind cap on the rear side.
   Disconnect the screws at two places on the rear side (see Figure 9-3), and the blind cap may be removed. Also remove the nuts and spring washers which are attached internally.
4. Install the SC-0103.
   Fix it on the stays in four places. (See Figure 9-4.)
5. Change the connection of the connector pin 4.
   Pull out the connector pin 4 which is connected to the SC-7501 (see Figure 9-4), and connect the connector pin 4 of the SC-0103 in that place (see Figure 9-5).



Caution

Since the connector pin 4 is of the lock type, in order to disconnect it, it must be pulled as it is pushed in the arrow direction. When connecting it, make sure that it is locked.

6. Install the supplied panel on the rear panel.

Figure 9-1

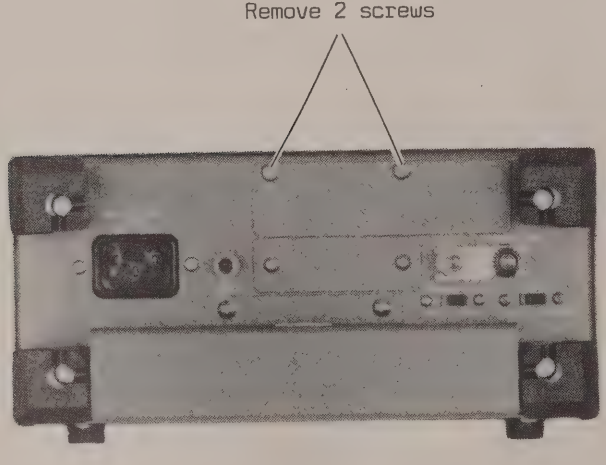


Figure 9-2

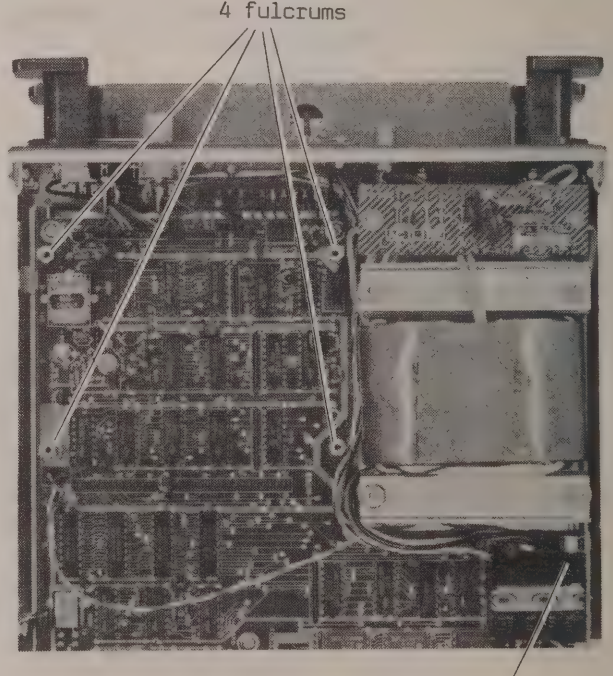
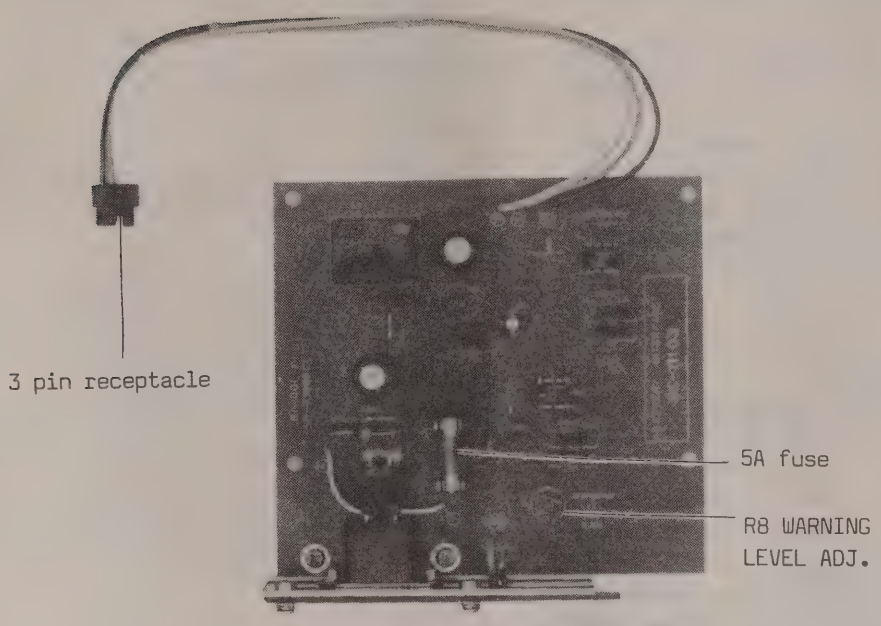


Figure 9-3 Top of SC-0103



9-4. OPERATING PROCEDURE

Installing the SC-7501 to the battery interface, and when using an external battery as the power source, connect the DC LINE INPUT on the rear panel with the external battery or with the cigarette lighter socket of the car using the supplied car battery cord.
A car battery (+12 V series) or a chargeable battery pack Ni-Cd (+12 V series) can be used as the external battery.
In addition, when the external battery is connected, if the AC power supply is interrupted during the operation with AC power supply, the operation will continue with the external battery automatically actuated.

Cautions

- If input source voltage (external battery) becomes below 9.55 V or 9.56 V, the WARNING indicator lamp lights up, indicates that SC-7501 will not operate at a voltage below this. In this case, charge the external battery and then use it again.
- If SC-7501 would not operate even with the external battery connected, the fuse FSA-5A of SC-0103 (see Figure 9-3) may be broken. In this case, carefully check the reasons therefore, repair any faulty point, and then replace the broken fuse with the specified fuse.

9-5 CHECK AND ADJUSTMENT

In order to take the correct measurement, each circuit in the battery interface SC-0103 should operate normally, and specifications of the battery interface SC-0103 should be always maintained in good order.
Check and adjust every about 6 months, and the reliable specificaiton will be maintained for a long term.

9-5-1 Precautions on Check and Adjustment

In checking and adjusting, observe the following precautions:

- Set the ambient temperature to the normal temperature (+23°C ± 5°C), and the humidity to 80% RH or less.

9-5-2 Equipments Required for Check and Adjustment

Before making check and adjustment, prepare the following equipments:

1. Digital multi-meter that can measure up to 12 V.
2. + 12 V power source that can vary the output voltage.

9-5-3 WARNING Level

Rating
The minimum level of the input power source voltage is from 9.55 V to 9.65 V.

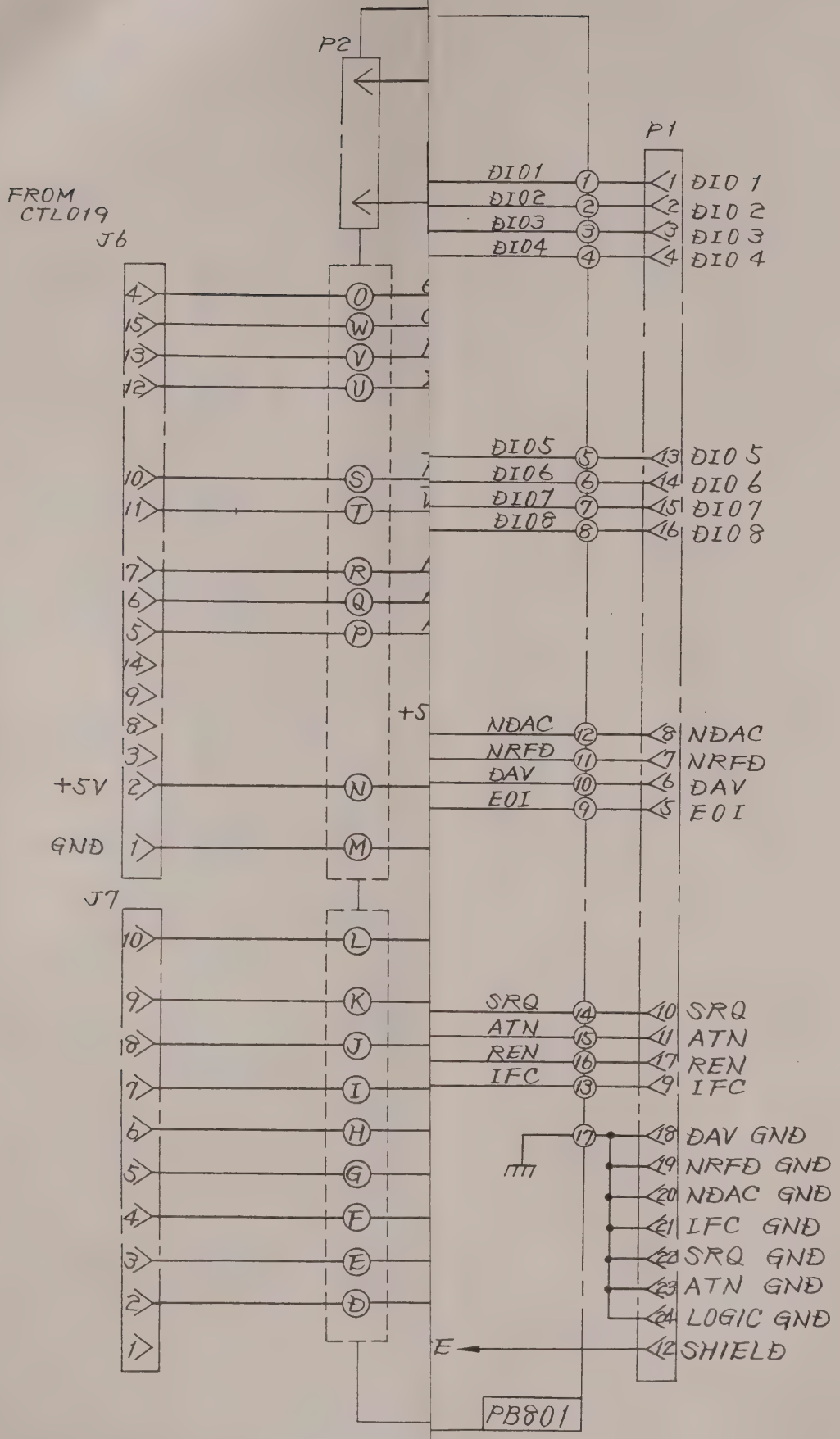
Check and Adjustment

1. Connect the supplied car battery cord between the input power source voltge of SC-0103 and the + 12 V power source.
2. Turn on the power of SC-7501, and vary the voltage of the + 12 V power source from 9.55 to 9.65 V. At this time, check if the WARNING indicator lamp lights up in this voltage range.
3. If the indicator lamp would not light up, adjust the WARNING LEVEL ADJ (see Figure 9-3).

9-5-4 Switching between AC Line and External Battery

Check

1. Operate SC-7501 with AC line supply voltage.
2. Connect the external battery to DC LINE INPUT of SC-0103.
3. Connect and disconnect the AC power cord from AC line plug socket. Check at this time that there is no fluctuation in the operation of SC-7501.



NOTE : UNLESS OTHERWISE
1. ALL RESISTANCE VAL
2. ALL CAPACITANCE VAL

GP-IB INTERFACE
SC-0101 12

K-800785

9-4. OPERATING PROCEDURE

Installing the SC-7501 to the battery interface, and when using an external battery as the power source, connect the DC LINE INPUT on the rear panel with the external battery or with the cigarette lighter socket of the car using the supplied car battery cord.
A car battery (+12 V series) or a chargeable battery pack Ni-Cd (+12 V series) can be used as the external battery.
In addition, when the external battery is connected, if the AC power supply is interrupted during the operation with AC power supply, the operation will continue with the external battery automatically actuated.

Cautions

- If input source voltage (external battery) becomes below 9.55 V or 9.56 V, the WARNING indicator lamp lights up, indicates that SC-7501 will not operate at a voltage below this. In this case, charge the external battery and then use it again.
- If SC-7501 would not operate even with the external battery connected, the fuse FSA-5A of SC-0103 (see Figure 9-3) may be broken. In this case, carefully check the reasons therefore, repair any faulty point, and then replace the broken fuse with the specified fuse.

9-5 CHECK AND ADJUSTMENT

In order to take the correct measurement, each circuit in the battery interface SC-0103 should operate normally, and specifications of the battery interface SC-0103 should be always maintained in good order.
Check and adjust every about 6 months, and the reliable specificaiton will be maintained for a long term.

9-5-1 Precautions on Check and Adjustment

In checking and adjusting, observe the following precautions:

- Set the ambient temperature to the normal temperature (+23°C ± 5°C), and the humidity to 80% RH or less.

9-5-2 Equipments Required for Check and Adjustment

Before making check and adjustment, prepare the following equipments:

1. Digital multi-meter that can measure up to 12 V.
2. + 12 V power source that can vary the output voltage.

9-5-3 WARNING Level

Rating
The minimum level of the input power source voltage is from 9.55 V to 9.65 V.

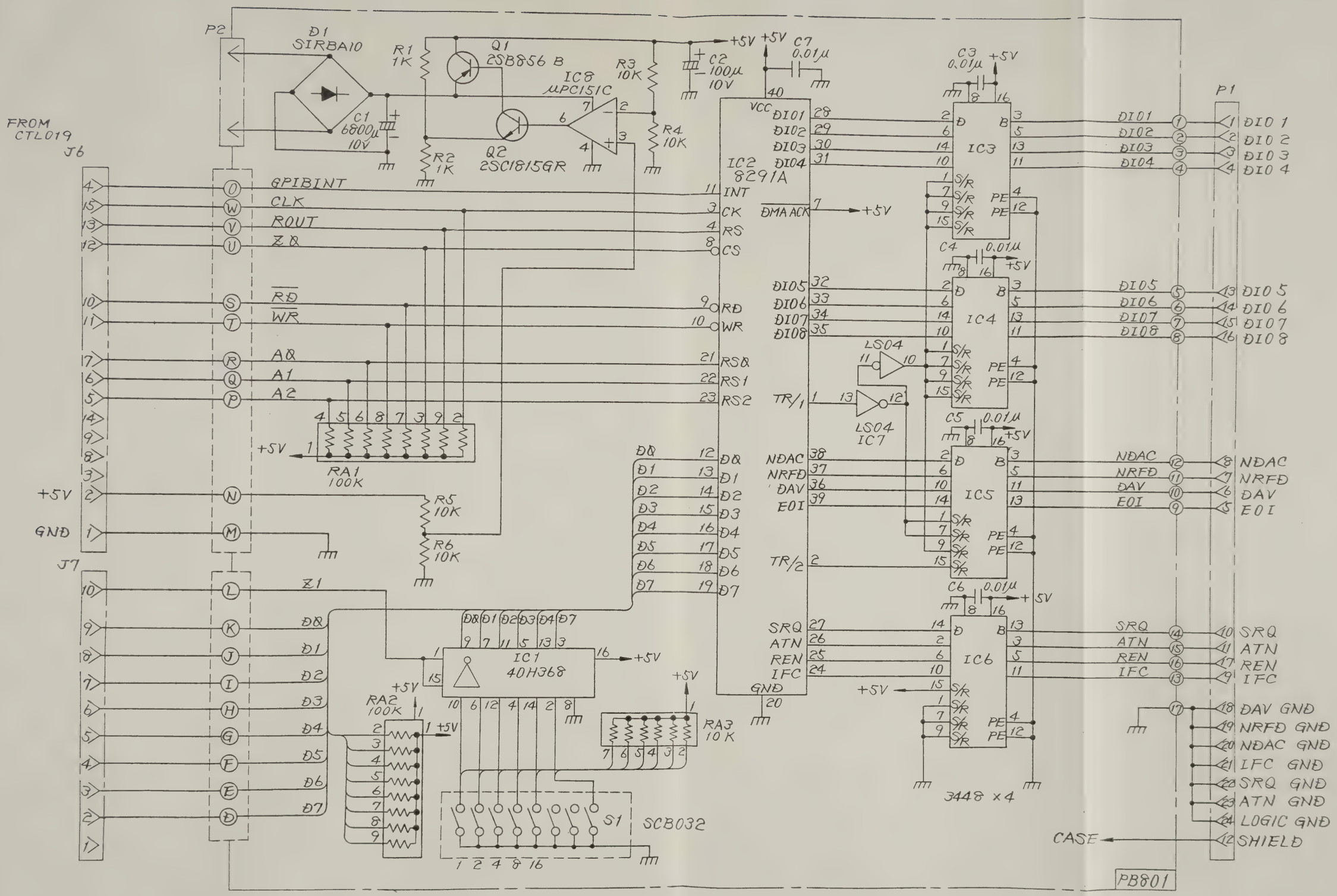
Check and Adjustment

1. Connect the supplied car battery cord between the input power source voltge of SC-0103 and the + 12 V power source.
2. Turn on the power of SC-7501, and vary the voltage of the + 12 V power source from 9.55 to 9.65 V. At this time, check if the WARNING indicator lamp lights up in this voltage range.
3. If the indicator lamp would not light up, adjust the WARNING LEVEL ADJ (see Figure 9-3).

9-5-4 Switching between AC Line and External Battery

Check

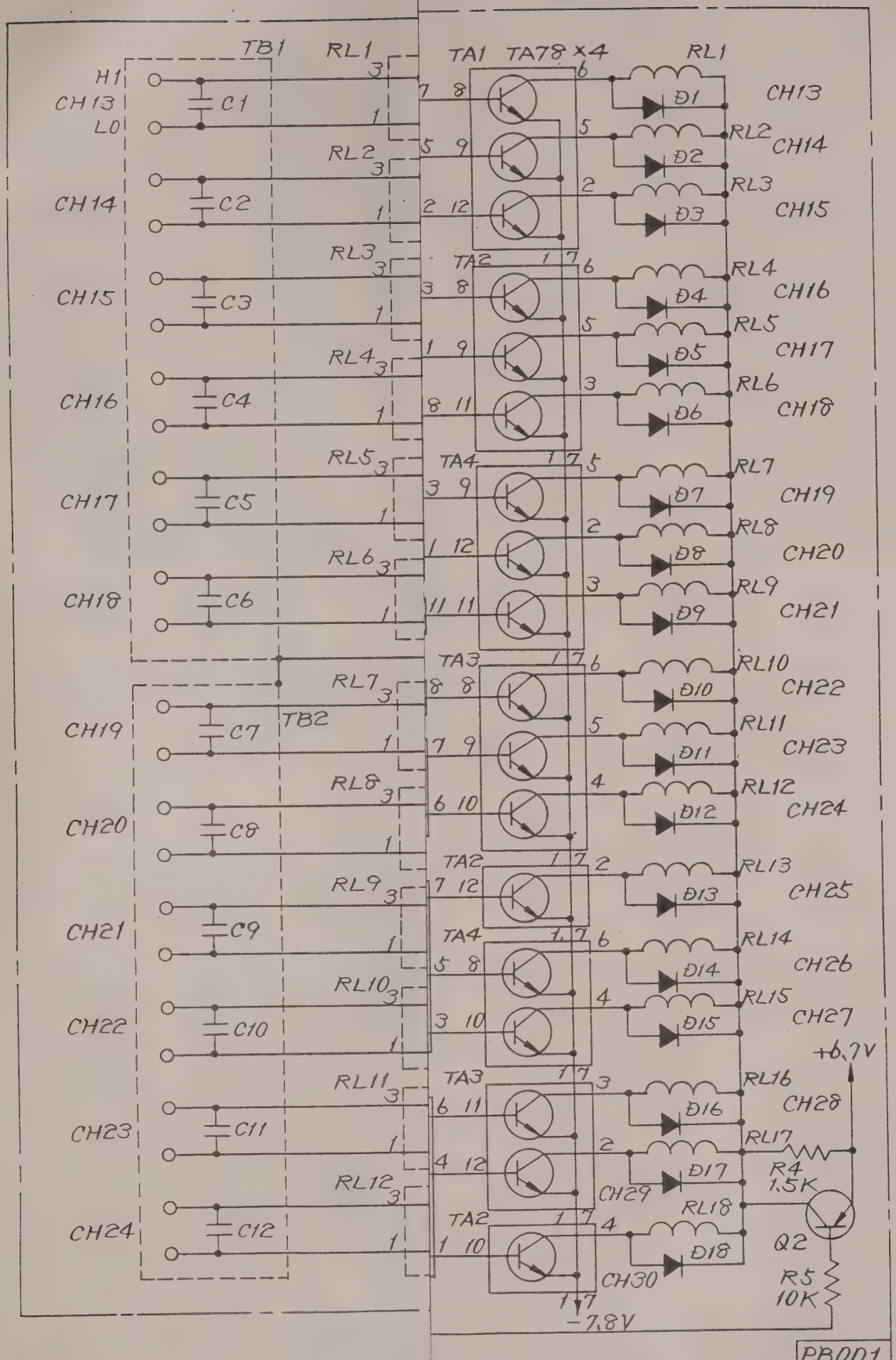
1. Operate SC-7501 with AC line supply voltage.
2. Connect the external battery to DC LINE INPUT of SC-0103.
3. Connect and disconnect the AC power cord from AC line plug socket. Check at this time that there is no fluctuation in the operation of SC-7501.



NOTE : UNLESS OTHERWISE SPECIFIED.

1. ALL RESISTANCE VALUES ARE ¼W IN OHMS.
2. ALL CAPACITANCE VALUES ARE IN PICOFARADS

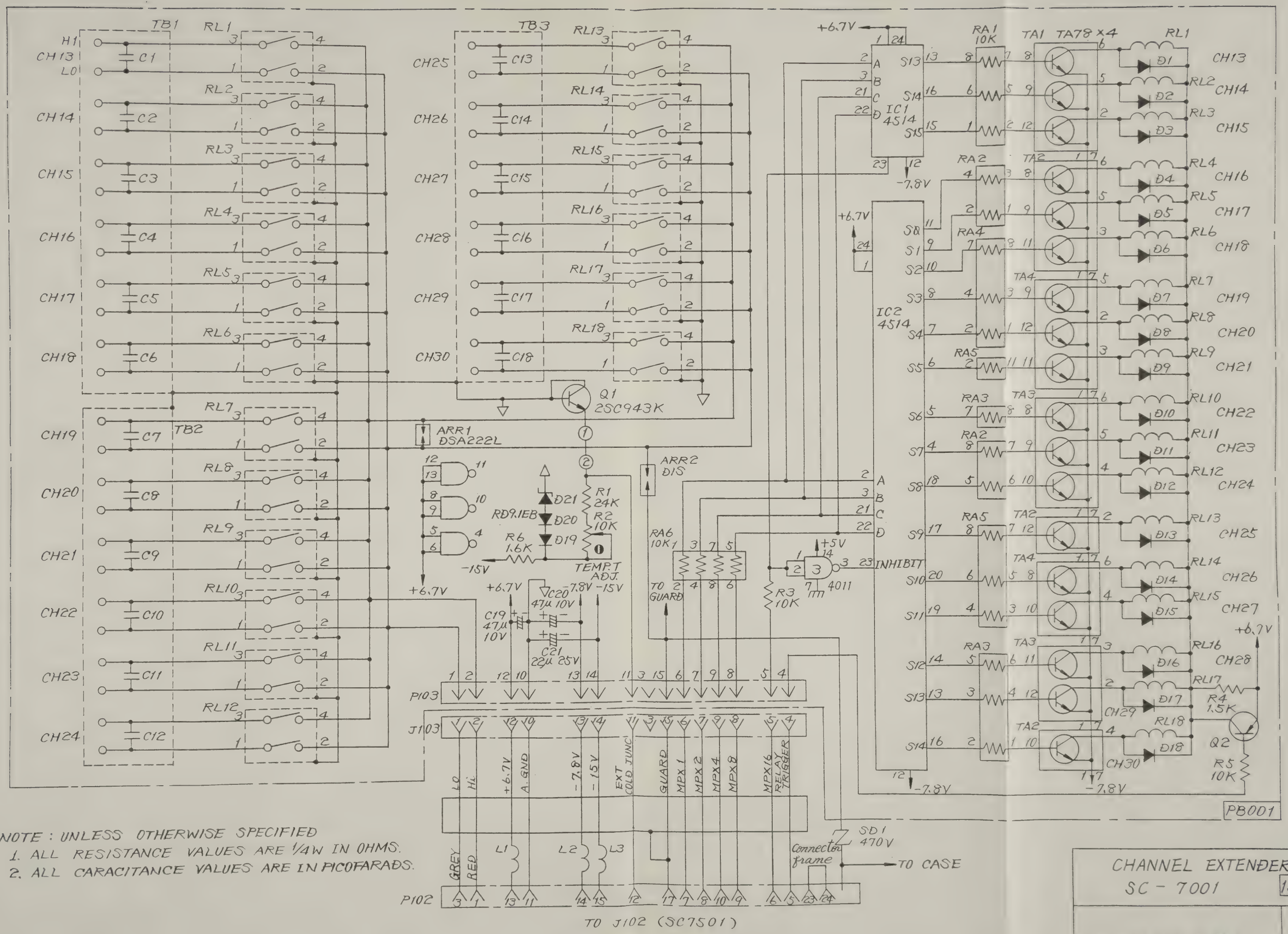
GP-IB INTERFACE SC-0101	12
K-800785	



NOTE : UNLESS OTHERWISE SP
1. ALL RESISTANCE VALUES
2. ALL CARACITANCE VALUES

CHANNEL EXTENDER
SC - 7001 13

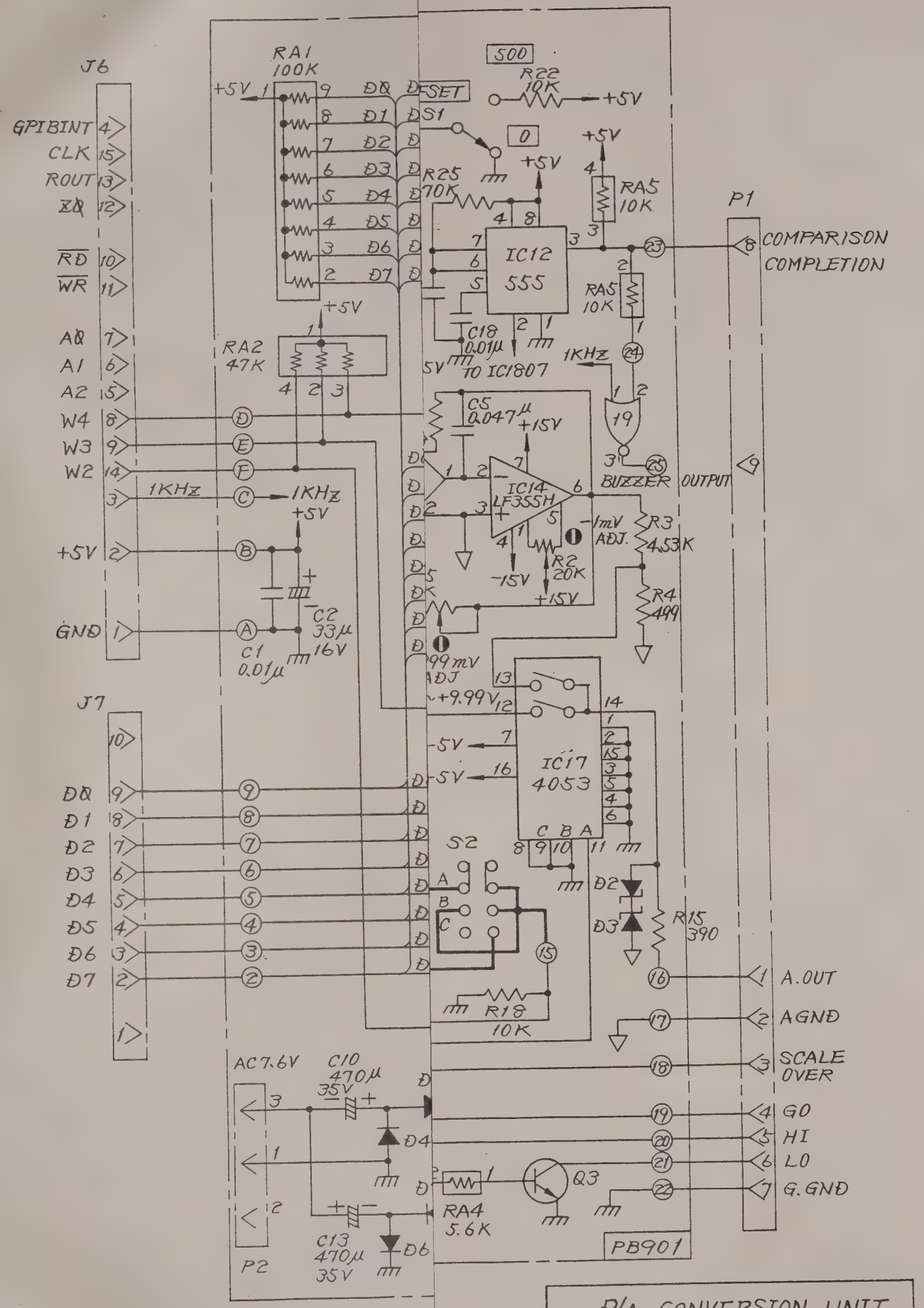
K-800786



NOTE : UNLESS OTHERWISE SPECIFIED
1. ALL RESISTANCE VALUES ARE 1/4W IN OHMS.
2. ALL CARACITANCE VALUES ARE IN PICOFARADS.

CHANNEL EXTENDER
SC - 7001 13

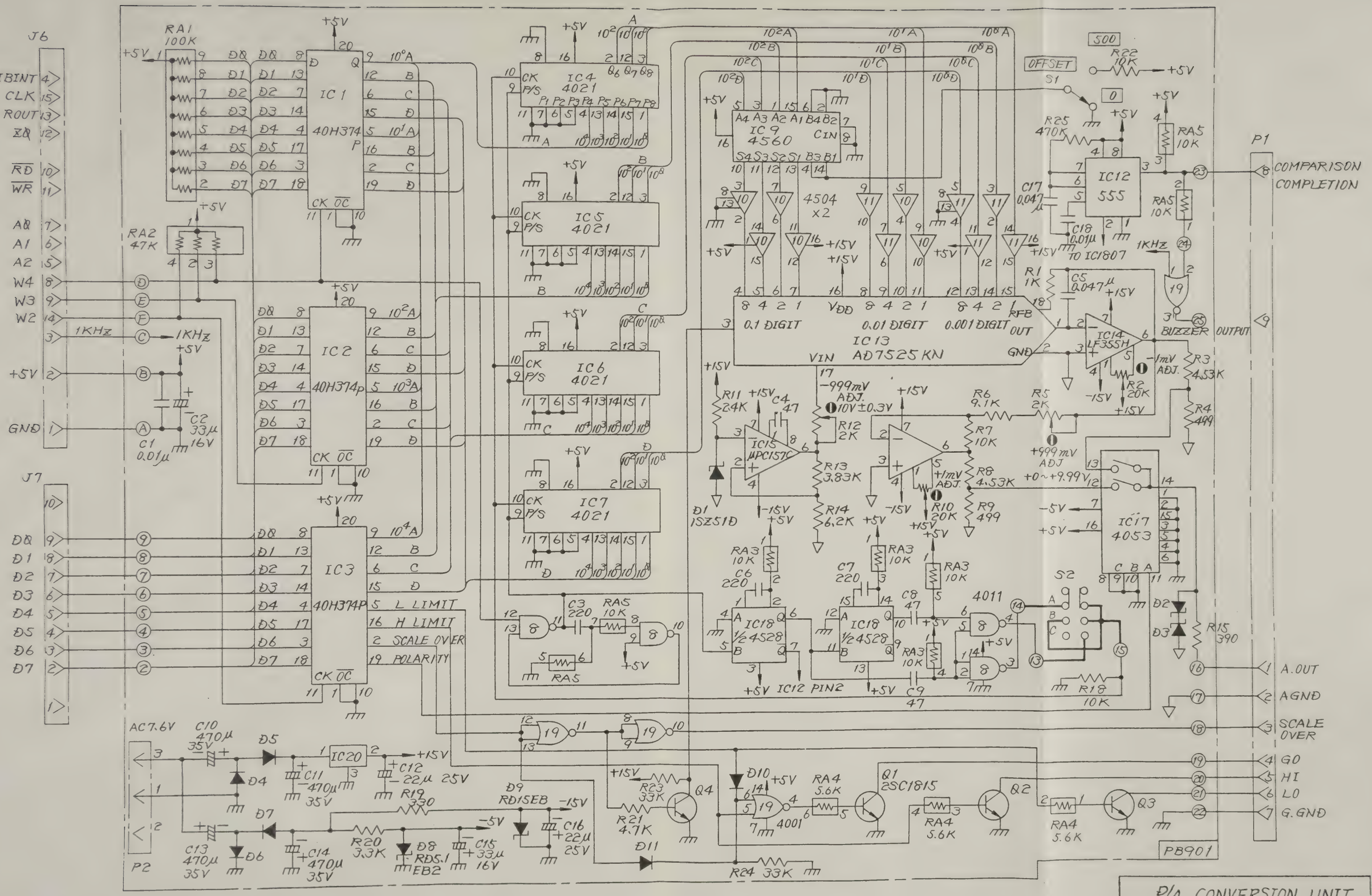
K-800786



NOTE: UNLESS OTHERWISE S
1. ALL RESISTANCE VALUE
2. ALL CAPACITANCE VALU

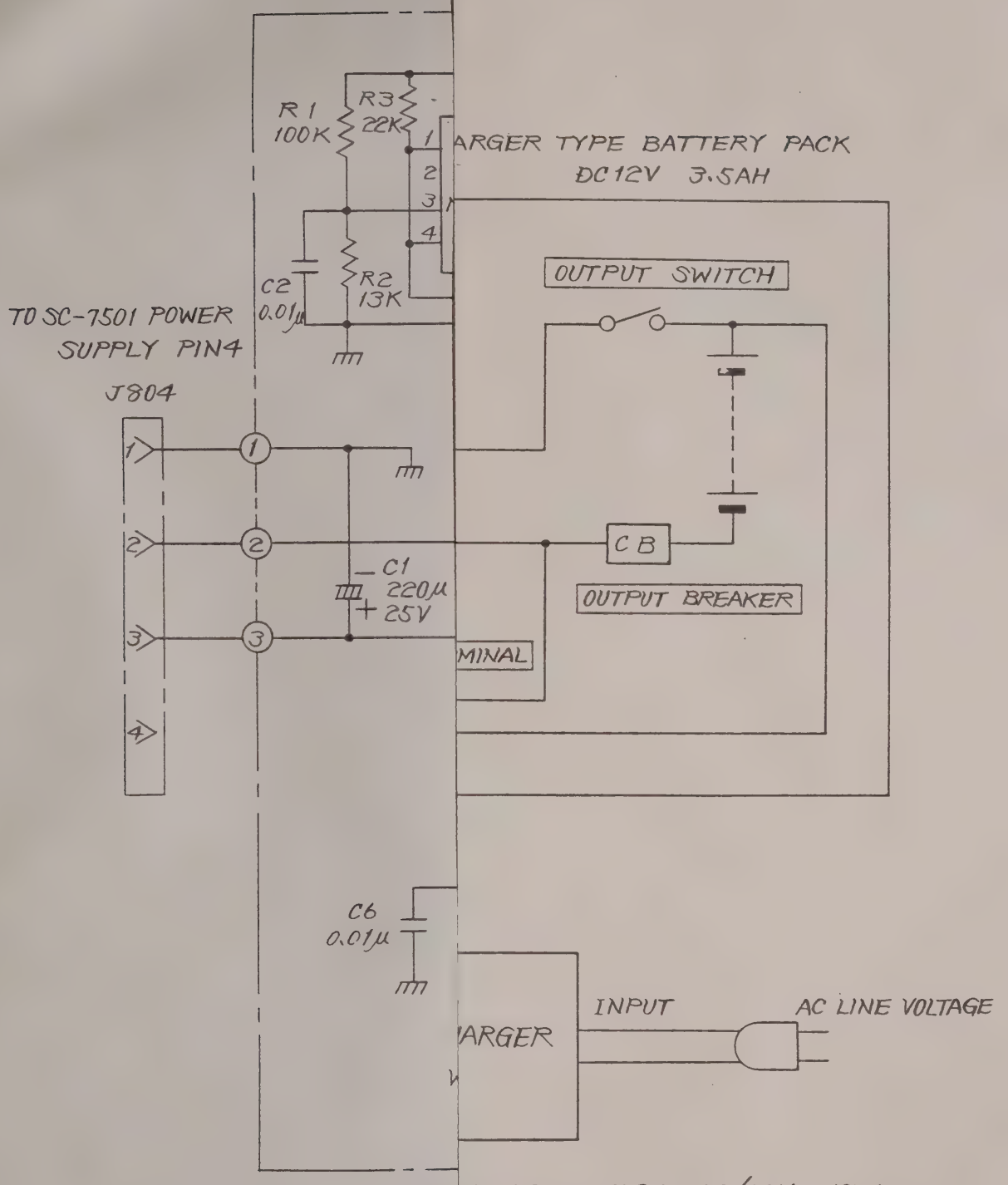
D/A CONVERSION UNIT
SC-0102 14

K-800787



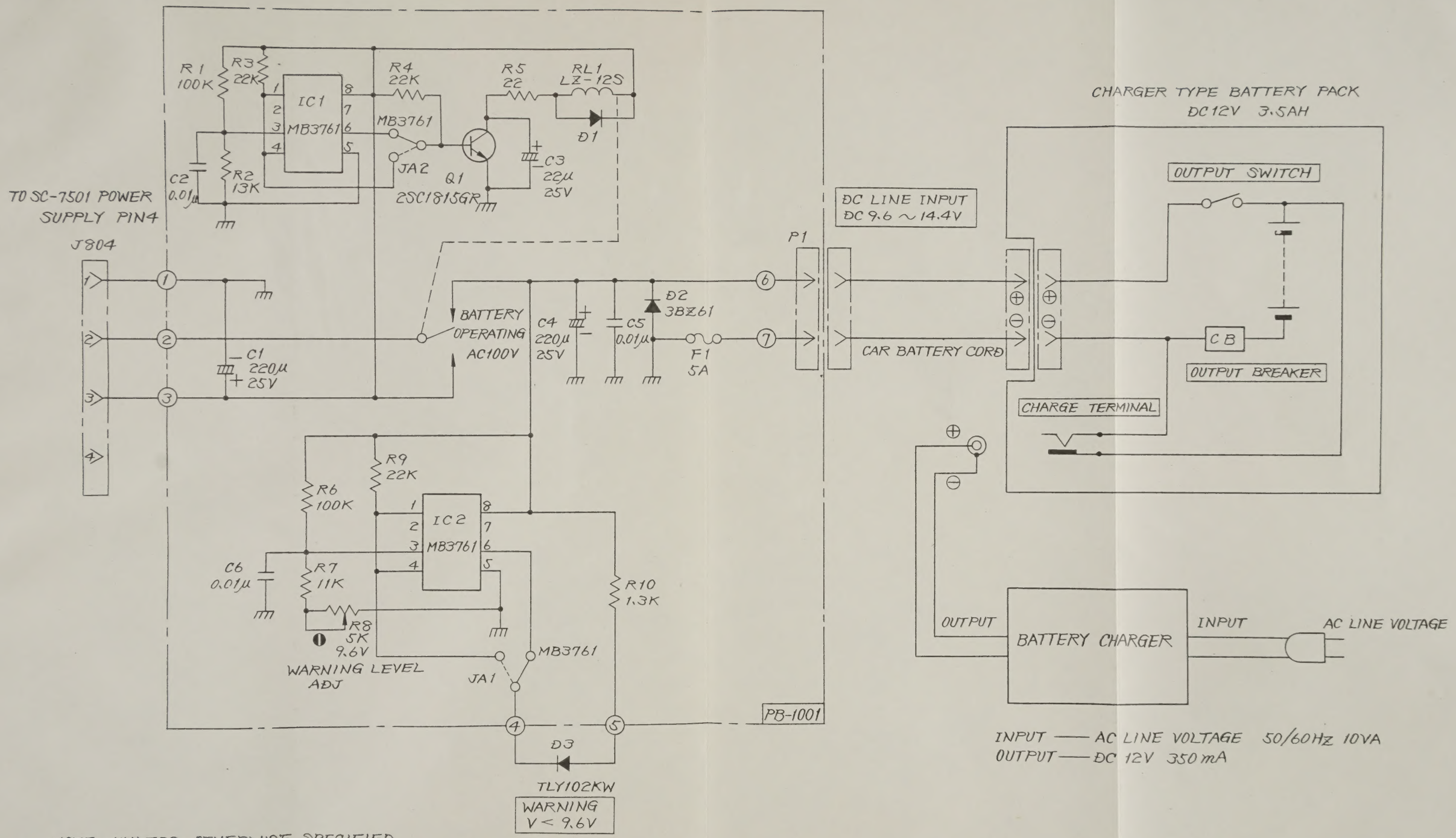
NOTE: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTANCE VALUES ARE 1/4W IN OHMS.
2. ALL CAPACITANCE VALUES ARE IN PICOFARADS.

D/A CONVERSION UNIT SC-0102	14
K-800787	



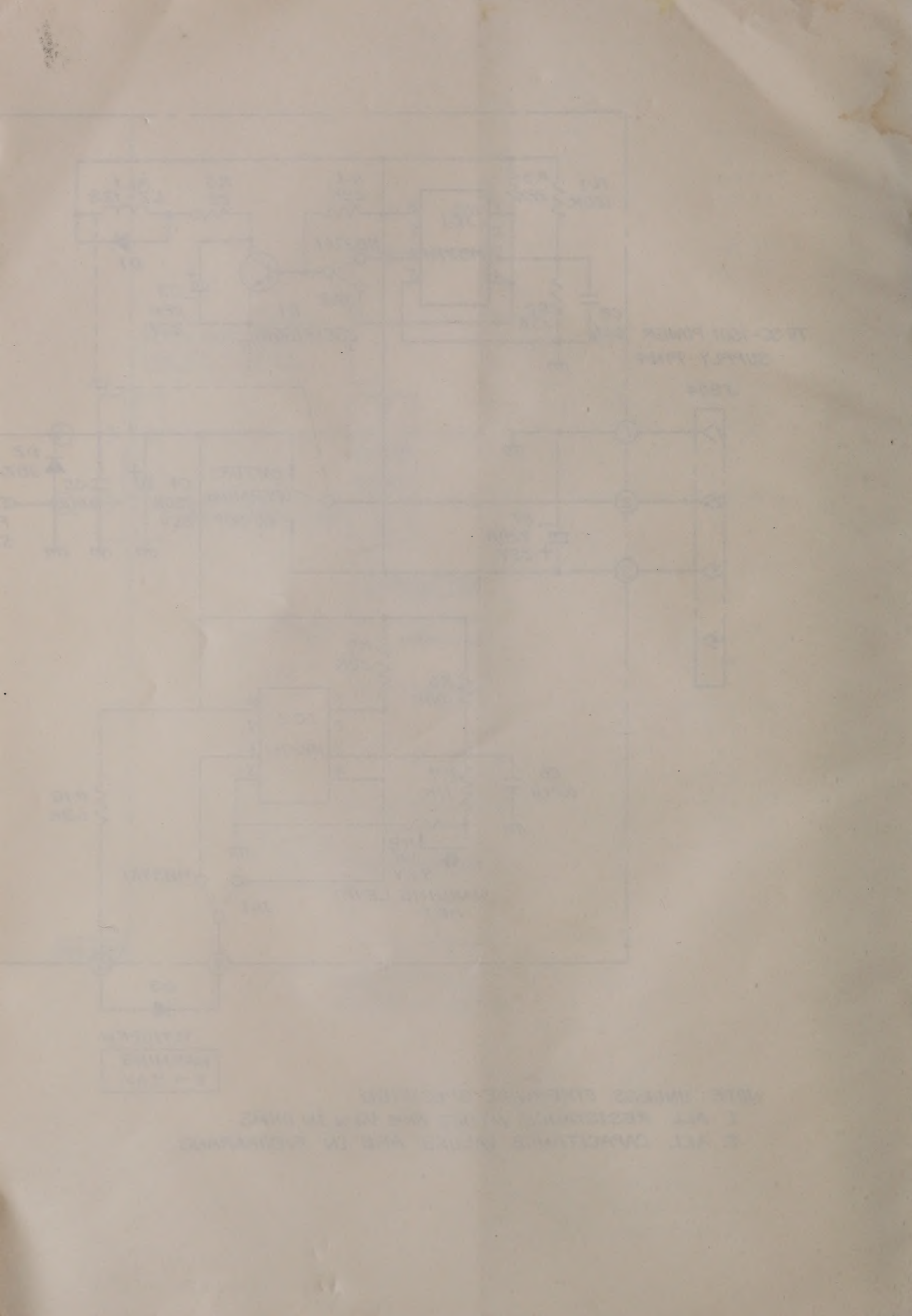
NOTE: UNLESS OTHERWISE
1. ALL RESISTANCE VAL
2. ALL CAPACITANCE V

BATTERY INTERFACE SC-0103	15
K-800788	



NOTE: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTANCE VALUES ARE 1/4W IN OHMS.
2. ALL CAPACITANCE VALUES ARE IN PICOFARADS.

BATTERY INTERFACE SC-0103	15
K-800788	



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